



22102159016





Digitized by the Internet Archive  
in 2014

<https://archive.org/details/b2039522x>



PRESENTED TO THE LIBRARY

BY

THE MISSES A. G. & V. BOWSTEAD,





THE

A. M. BOWSTEAD, Esq.,  
Caistor,  
Lincolnshire.

# SURGEON'S POCKET-BOOK ;

BEING AN ESSAY ON THE

BEST TREATMENT OF WOUNDED IN WAR,

FOR WHICH A PRIZE WAS AWARDED BY HER MAJESTY THE QUEEN OF  
PRUSSIA AND EMPRESS OF GERMANY IN THE YEAR 1874.

SPECIALLY ADAPTED FOR THE PUBLIC  
MEDICAL SERVICES.

BY

(SURGEON-MAJOR) J. H. PORTER,

LATE 97TH REGIMENT,

ASSISTANT-PROFESSOR OF MILITARY SURGERY, ARMY MEDICAL SCHOOL, NETLEY.

LONDON:

CHARLES GRIFFIN AND COMPANY,  
STATIONERS' HALL COURT.

1875.

[All Rights Reserved.]

14628160

LONDON :

PRINTED BY WILLIAM CLOWES AND SONS,  
STAMFORD STREET AND CHARING CROSS.

M15052

WELLCOME INSTITUTE LIBRARY	
Coll.	we!MOMec
Call	M:
No.	W0800.
	1875.
	P84s

## P R E F A C E.



HAVING had some experience in the treatment of wounded soldiers during the Crimean campaign, the Indian Mutiny, and the Franco-German War of 1870-71, I was induced to compete for a prize offered by Her Majesty the Queen of Prussia and Empress of Germany, for the best Essay on the "Practical Treatment of Wounded in War."

The prize judges, Professors Billroth of Vienna, Baron von Langenbeck of Berlin, and Socin of Basle, awarded my Essay a prize, which I now publish at the earnest request of my friends in the Medical Profession.

The great difficulty of preparing a work to meet the ever-recurring emergencies of war will, I trust, be sufficient excuse for any shortcomings which may be found in it. It must be observed that the army surgeon of the present day has, as a rule, to deal with wounded under very different circumstances from his predecessors.

Railways, improved transport and field appliances, as well as the privileges of the "Geneva Convention," have given to wounded soldiers better prospects of recovery in many respects; but experience has sufficiently proved that modern surgeons may still be placed, under exceptional circumstances, in no better position for the care of their wounded than were those of former days. On this account I have detailed the surgical rules of the older surgeons, as well as of those of the present day, presuming that my readers will not omit to consider the circumstances of each particular case that falls under their care, and be guided in applying the rules given in the manual in accordance with them.

Take, for example, the circumstances of men with wounds in or near to a Continental town, with every comfort and appliance at hand, and those of others with similar wounds on such a field as that of Alma, Magdala, or

Coomassie, with the necessity for immediate long transport and exposure :—how different must be the plans of treatment adopted in some of these injuries !

I have included several subjects which might at first sight be considered extraneous to the purpose of a surgical manual, such as a scale of hospital diets, construction of cooking-places, of camp ovens, extemporary water filters, and latrines ; but, from experience in the field, I know how important for the present comfort of patients and the ultimate results of their injuries it is to the surgeon to have memoranda on these matters at hand for easy reference. These formed a portion of the contents of the original Essay, but to the present publication I have also appended the Formulary of Prescriptions which is now in general use in Military Hospitals. I have found the use of this formulary a means of facilitating work and saving time, and have therefore thought it would prove a convenient addition to the manual.

In the preparation of this Essay I lay no claim to literary merit or originality. My object has been simply to present to the surgeon such information as I myself found the want of during my campaigns ; and in doing so I have extensively made use of the labours of others, to whom I am indebted, but who, like myself, will, I am sure, be well rewarded, if their efforts tend to mitigate in the smallest degree the sufferings of the unfortunate wounded in war.

J. H. PORTER.

WOOLSTON,  
*May, 1875.*



# CONTENTS.



	PAGE		PAGE
Preface . . . . .	iii	Treatment of gun-shot wounds . . . . .	45
General remarks . . . . .	1	Use of bandages in ditto . . . . .	45
Surgical instruments . . . . .	2	Warm baths for ditto . . . . .	46
Dress of the soldier . . . . .	2	Irrigation in ditto . . . . .	48
Carriage of stretchers . . . . .	2	Poultices in ditto . . . . .	50
Extemporary transport . . . . .	6	Disinfectants in ditto . . . . .	50
Cacolets . . . . .	10	Constitutional treatment in ditto . . . . .	51
First line of surgical assistance . . . . .	13	Sanitary treatment in ditto . . . . .	51
Macdonald's ambulance lift . . . . .	14	Bayonet wounds . . . . .	52
After an engagement . . . . .	16	Lance ditto . . . . .	52
Wounded to be first relieved . . . . .	16	Sword ditto . . . . .	52
Pain of a gun-shot wound . . . . .	17	Arrow ditto . . . . .	52
Bandages . . . . .	17	Injuries of the head . . . . .	55
Extemporary appliances for fractures . . . . .	18	Wounds of the face and adjacent parts . . . . .	70
Extemporary pads and cushions . . . . .	26	"    "    neck . . . . .	76
Plaster of Paris bandages . . . . .	26	"    "    chest . . . . .	79
Swinburne's brancard . . . . .	32	"    "    abdomen . . . . .	96
Appia's fracture apparatus . . . . .	33	"    "    spine . . . . .	107
Wounds, how inflicted . . . . .	36	"    "    pelvis . . . . .	111
Incised wounds . . . . .	37	"    "    perineum and genital and urinary organs . . . . .	114
Punctured wounds . . . . .	37	"    "    extremities . . . . .	115
Lacerated wounds . . . . .	37	Simple and compound fractures on the field . . . . .	116
Contused wounds . . . . .	38	Gun-shot fractures of the upper ex- tremities . . . . .	117
Wind balls . . . . .	38	Gun-shot fractures of the lower ex- tremities . . . . .	121
How gun-shot wounds are influenced . . . . .	39	Wounds of joints considered . . . . .	140
Examination of wounds . . . . .	39		
Exploring for missiles . . . . .	39		
Extraction of bullets . . . . .	42		
Wounds not having free exit . . . . .	44		



	PAGE		PAGE
Wounds of the shoulder-joint . . .	142	Cauterization . . . . .	207
"    "    elbow-joint . . .	143	Styptics . . . . .	207
"    "    wrist-joint . . .	144	Wounds of veins . . . . .	203
"    "    hip-joint . . .	145	Punctured wounds of arteries. . .	208
"    "    knee-joint . . .	146	Diffuse traumatic aneurism . . .	208
"    "    ankle-joint . . .	148	Circumscribed traumatic aneurism . . .	203
"    "    foot . . . . .	149	Aneurismal varix . . . . .	209
"    of nerves and tendons . . .	150	Arteritis . . . . .	209
Anæsthesia . . . . .	151	Ligature of arteries . . . . .	210
Shock . . . . .	152	Mortification or gangrene . . . . .	218
AMPUTATION . . . . .	153	Bed-sores . . . . .	220
Period for performing it . . .	153	Tetanus . . . . .	223
Cases demanding it . . .	157	Hospital gangrene . . . . .	228
Approved methods . . .	157	Erysipelas . . . . .	235
Double amputation . . .	158	Phlebitis . . . . .	238
Washing out of stumps . . .	158	Pyæmia . . . . .	240
After-treatment of stumps . . .	158	Septicæmia . . . . .	243
Bloodless method of amputating . . .	159	Osteo-myelitis . . . . .	245
Amputations described. . .	160	Scurvy . . . . .	249
Excisions described. . .	183	Footsoreness . . . . .	250
Affections of stumps . . .	198	Cooking-places . . . . .	251
HÆMORRHAGE . . . . .	199	Field ovens . . . . .	251
Primary . . . . .	199	Latrines . . . . .	253
Intermediary. . . . .	201	Extemporary water filters . . . . .	254
Secondary . . . . .	201	Diets . . . . .	255
Hæmorrhage from stumps . . .	201	Scale of diets . . . . .	256
"    expedients for sup- pressing . . . . .	203	Classification of wounds (Taylor's) . . .	258
"    tourniquet in . . .	203	Return of capital operations . . . . .	263
Extemporary tourniquets . . .	204	Classification of wounds for particular battles . . . . .	264
Torsion of arteries . . . . .	206	Formulary of prescriptions . . . . .	267
Acupressure . . . . .	207		

# ILLUSTRATIONS.



FIG.				PAGE
1.	Extemporary stretcher constructed with a ship's hammock and pole . . . . .			6
2.	Ditto	ditto	a ship's cot and pole . . . . .	6
3.	Ditto	ditto	two poles and strong cloth or linen . . . . .	7
4.	Ditto	ditto	two poles and straps . . . . .	7
5.	Ditto	ditto	two poles and hay or straw ropes . . . . .	8
6.	Ditto	ditto	four rifles and two great coats . . . . .	8
7.	Ditto	ditto	two rifles and one great coat . . . . .	9
8.	Ditto	ditto	two rifles and one great coat . . . . .	9
9.	Ditto	ditto	two poles and ropes . . . . .	10
10.	Ditto	ditto	two rifles and two soldiers' knapsacks . . . . .	11
11.	Galton's extemporary stretcher . . . . .			12
12.	Macdonald's ambulance lift for ship or shore . . . . .			14
13.	Esmarch's triangular bandage. . . . .			18
14.	Extemporary appliance for fracture of the thigh, constructed with a rifle and great coat . . . . .			19
15.	Ditto	ditto	constructed with two splints . . . . .	19
16.	Extemporary appliance for fracture of the leg, constructed with a splint and soldier's great coat . . . . .			19
17.	Ditto	ditto	ditto a soldier's knapsack . . . . .	20
18.	Ditto	ditto	ditto a board . . . . .	20
19.	Ditto	ditto	ditto a sword scabbard . . . . .	21
20.	Ditto	ditto	ditto a roll of straw . . . . .	21
21.	Extemporary appliance for fractures of long bones, constructed with cloth and rolls of straw . . . . .			22
22.	Extemporary appliance for fracture of the humerus, constructed with bayonet and scabbard . . . . .			22
23.	Ditto	ditto	ditto with thin pieces of board . . . . .	23
24.	The French trough splint . . . . .			24
25.	Duncan's rattan splint . . . . .			24
26, 27.	Wyatt's splint . . . . .			25

FIG.	PAGE
28. Splint constructed with twigs or brushwood . . . . .	26
29. Diagram for flannel for Moffitt's plaster of Paris bandage for the leg . . . .	28
30. Diagram for flannel for Port's plaster of Paris bandage for the leg . . . .	29
31, 32. Bavarian (Port's) method of applying plaster of Paris bandages . . . .	30
33. Volcer's first step in applying plaster of Paris bandage to leg or thigh. . . .	31
34. Volcer's second step, ditto . . . . .	31
35. Volcer's third step, ditto . . . . .	32
36. Swinburne's brancard . . . . .	32
37—42. Appia's fracture apparatus . . . . .	33—36
43. Nélaton's probe . . . . .	41
44. Lecomte's probe . . . . .	41
45. Electric explorer . . . . .	43
46. Foot-bath . . . . .	46
47. Arm-bath . . . . .	46
48. Esmarch's irrigator . . . . .	47
49. Velpeau's irrigator . . . . .	48
50. Irrigator and kidney-shape dressing-tray . . . . .	49
51. Wire loop for extracting arrow-heads . . . . .	53
52. Wire twister for ditto . . . . .	53
53. Method for applying wire loop for ditto . . . . .	54
54. Holston's chisel . . . . .	64
55. Splint for fractures of the lower jaw . . . . .	71
56. Ditto ditto . . . . .	72
57. Ditto ditto applied. . . . .	72
58. Erichsen's method for stitching wounds of the intestines . . . . .	103
59—61. Vézine's ditto ditto . . . . .	104, 105
62, 63. Stromeyer's pad for fractures of the humerus . . . . .	118, 119
64. Hodgen's apparatus for gun-shot fractures of the thigh . . . . .	130
65. Hodgen's suspending apparatus for ditto ditto . . . . .	131
66, 67. Smith's suspending apparatus for ditto ditto . . . . .	132
68, 69. Esmarch's apparatus for ditto ditto . . . . .	133
70. Erichsen's bracketed apparatus for ditto ditto . . . . .	134
71. Appareil Bonnet for ditto ditto . . . . .	135
72. Stromeyer's apparatus for ditto ditto . . . . .	136
73—75. Sarazin's apparatus for ditto ditto . . . . .	137, 138
76. Esmarch's splint for excision of the elbow . . . . .	143
77, 78. Esmarch's splint for resection of the wrist . . . . .	144
79. Cripps's method for the bloodless operation . . . . .	160
80. Amputation at the shoulder-joint . . . . .	161

FIG.	PAGE
81. Amputation at the shoulder-joint by transfixion . . . . .	162
82. Circular amputation of the arm . . . . .	163
83. Amputation of the arm above elbow by transfixion . . . . .	164
84. Ditto of the forearm by transfixion . . . . .	166
85. Ditto at wrist . . . . .	167
86. Ditto of fore and little fingers . . . . .	168
87. Ditto at the hip-joint, Lisfranc's method . . . . .	169
88. Ditto ditto Guthrie's method . . . . .	170
89. Ditto ditto Fergusson's method . . . . .	172
90. Ditto of the thigh, similar to Vernal's method . . . . .	174
91, 92. Ditto through the knee, Carden's method . . . . .	176
93. Ditto of the leg by oval method . . . . .	177
94. Ditto of the leg, single flap . . . . .	178
95. Ditto at the ankle (Syme's method) . . . . .	178
96, 97. Ditto of leg by Teal's method . . . . .	181
98. Lister's splint for excision of the wrist . . . . .	187
99. Splint for excision of the hip-joint . . . . .	188
100. Butcher's splint for excision of the knee-joint . . . . .	190
101—103. Watson's splint for excision of the knee-joint . . . . .	191
104. Excision of the ankle by Guthrie's method . . . . .	193
105. Esmarch's splint for excision of the ankle . . . . .	195
106, 107. Ditto ditto . . . . .	196
108. Mott's tourniquet . . . . .	204
109. Volker's tourniquet . . . . .	204
110. Esmarch's tourniquet . . . . .	205
111. Swiss tourniquet . . . . .	205
112. Spencer Wells's torsion forceps . . . . .	207
113. The reef-knot . . . . .	210
114. Porter's sling for the more convenient treatment of bed-sores . . . . .	221
115. Camp latrine . . . . .	252
116. Extemporary water filter . . . . .	252

## ERRATUM.

Page 75, line 15, *for* "or sack," *read* "or sac."

# THE SURGEON'S POCKET BOOK.

---

*General Remarks.*—The duties of the Army Surgeon, at all times responsible, are more especially so in time of war, and much of the success of troops is dependent upon the manner in which they have been executed.

Forethought is required in making suitable suggestions for preservation of health, and, when sickness and wounds occur, proper organization for the care and treatment of the sufferers.

It is not always possible that officers commanding forces in front of an enemy can attend to the strict rules of hygiene on account of being obliged to take up certain positions with regard to tactics, it is therefore the duty of the responsible surgeon to make the most of such positions, and with the means at his disposal offer such suggestions as will conduce to the health and comfort of those under his care. It is on these occasions, when difficulties have to be overcome, that the resources of the Army Surgeon are severely tested and his genius and training brilliantly brought out.

Regulations for preserving health do not appear to be required in this essay; it will therefore only be my aim to offer some practical assistance to the Army Surgeon when engaged with troops in time of war, and called upon to exercise his skill in the care of wounded.

Rules and regulations exist in all civilized countries for the organisation of transport, supply of stores, comforts, and medicines, also surgical instruments, under their respective departments, with which it is desirable that the surgeons in the field should have no responsibility, except for such as may be required for immediate use, their entire time and object being for the care and treatment of those under them.

Surgeons should make themselves acquainted with the *construction of all transport* for their sick and wounded, so as in the event of accidents in moving they can in some measure render temporary assistance, much suffering and delay being frequently occasioned by ignorance on the part of attendants in consequence of their not being able to set to rights trivial accidents.

*In taking the field*, either in immediate charge of troops or attached to

hospitals, it is essentially necessary to have a careful inspection of every article taken over, to become acquainted with the position or locale of medicines, instruments, medical comforts, bedding, cooking utensils, and such articles as may be required in a hurry, or at night, to detail each medical officer, non-commissioned officer, or hospital orderly, to his respective post, and to see they are acquainted with their duties; the necessity for doing so cannot be too strongly impressed, as it is only by each individual knowing exactly what his duties are, and relative position of articles in charge, that great confusion, unnecessary unpacking, and trouble can be prevented.

*Surgical instruments* should be special objects for care, as without their being in good order the surgeon is very little use on active service in the field. Guthrie justly remarks, "that a surgeon without his apparatus and equipment is little better than a battery without ammunition."

In dry climates, surgical instruments can be kept free from rust by thorough drying after use, the case being afterwards enclosed in waterproof covering. In moist climates they should be smeared with mercurial ointment, rubbing off the same when required for use.

The construction of a temporary field kitchen, hospital huts, latrines, and temporary cots, should engage the earnest attention of the army surgeon, as he may be placed in positions where regular artificers are not available; with, therefore, his knowledge on these matters, and the aid of a few orderlies, he may be able to afford shelter, properly cooked food, and comfort in a short time. He should also be acquainted with the method of pitching of tents and marquees, and the amount of space required for each.

It may be remarked that these matters do not belong to the duties of the Army Surgeon; but on service he will find that unless he is capable of supervising and directing them, much must be left undone, and those under his care must consequently suffer. And if the usual resources fail or are not at hand, he should by extemporaneous expedients succour the wounded and relieve the sick.

*An acquaintance with the dress of the soldier* may assist in discovering some cause for inability to march or keep up with the others, such as tight collars, or badly-fitting boots, wrinkles in trousers, &c.

*The carriage of sick and wounded* on stretchers is highly important, and the surgeon should be in a position to instruct those about him, in the event of regularly trained men not being available. As an instance of the serious consequences which may occur from want of proper training in the carriage of wounded, the writer may mention a case that occurred during the Crimean war. An officer received a wound in the trenches before Sevastopol; the men of his regiment placed him on a stretcher, which they lifted on their shoulders, having their rifles at the same time slung across



their bodies, muzzles uppermost: one accidentally exploded, inflicting a mortal wound on the unfortunate officer. Had these men been trained, they would not have carried the stretcher on their shoulders.

The following rules have been laid down by Professor Longmore for the proper carriage of stretchers, and which can scarcely be improved upon:—

“For several reasons, it is most desirable that three men should accompany every stretcher which is to be used for carrying wounded from the field of action. Two men are usually told off, but the third is required in case of either of the other two bearers becoming wounded, to act as a relief to the bearers during the transport, and to assist in placing upon the stretcher men who have met with serious fractures of bones from gun-shot. For these latter cases the presence of a third bearer is of essential importance. A patient with a fractured leg should never be lifted up and put on a stretcher by two bearers only, unless under extreme urgency.

“Before attempting to remove a badly-wounded man from the spot where he has fallen, the stretcher should be brought close up to him; the wounded man should not be carried by hand further than can be avoided. In placing the stretcher for this purpose, it should not be laid by the side of the patient, but at his head, and should not be placed cross-wise, but the length of the stretcher should be in the same direction as that in which the wounded man happens to be lying. By this means the patient is readily carried head forward over the canvas on which he is to lie, and the bearers move with a clear view of the stretcher before and between them, until the patient's head is directly over the pillow on which it is to rest.

“The front and rear bearers of the conveyance must start with opposite feet. They must not move in ‘in step,’ but, on the contrary, must march out of step, or, as the ordinary expression is, must ‘break step.’ If the man in front steps off left foot forward, the man in the rear must step off at the same moment right foot forward, or *vice versa*, and this broken step must be maintained throughout the whole distance of the transport.

“The bearers must march with a steady but easy step, particularly avoiding elevation of their bodies by springing from the fore part of the feet. The foot should be planted without any wavering on the ground at each step, and in moving forward it should only be raised sufficiently to clear the ordinary impediments on its surface. Some bearers, unless this rule is enforced, will make a slight spring in their movements, which spring is of course communicated to the more or less pliable conveyance they are carrying. They do so on the belief that the weight is sustained more easily in consequence of the elastic movement which is thus obtained, but they take no note of its ill effect on the person conveyed. Whether even or uneven as regards measure of time, great care must be taken lest the steps of the front and rear bearers are invariably even and alike in distance. If the steps do not well and accurately agree in length, there will constantly be a

## 4] *RULES FOR PROPER CARRIAGE OF STRETCHERS.*

---

hasty 'catching up' of one or other of the bearers; and the stretcher and patient will be jolted on every occasion when an effort is thus made to readjust the distance. If the bearers march with an exactly corresponding step as regards length this source of disturbance will be avoided.

"When distributing bearers, as far as circumstances permit, men nearly of the same height and strength should be selected for acting together. When a stretcher is supported by men of equal height and proportion, if the ground be level the stretcher will necessarily assume a horizontal position also, and men possessed of like degrees of strength will carry the weight and move together more evenly. If the ground be uneven the bearers will have to mutually adapt the height of their respective ends of the conveyance to the irregularities in order to preserve its level condition.

"When braces or shoulder-straps are used to assist the bearers in carrying stretchers, care should be taken at starting that they are buckled so that the parts supporting the poles are at equal distances from the surface of the ground.

"As most ground over which wounded men have to be carried is likely to present irregularities of surface, it becomes an important matter for bearers to practice the carriage of the stretchers so as to acquire a facility of keeping the stretcher level, notwithstanding the ground is uneven.

"If the ground over which the conveyance has to pass presents a general ascent, and the bearers are of different heights, then the rear or No. 2 bearer should be the taller and stronger man, for his greater height and the greater strength of his arm will be useful in supporting and raising the stretcher up to the level of the end carried by the foremost man. The weight of the stretcher will naturally be thrown in the direction of the man on the lower level.

"If the ground presents a general descent the front or No. 1 bearer should be the taller and stronger, for the same reasons as those just given as regards the No. 2 bearer under the opposite circumstances.

"A sick or wounded person on a stretcher should be carried, if the ground be tolerably level, with his face looking toward the direction in which the bearers walk. The front or No. 1 bearer then supports the end of the stretcher at which the patient's feet are placed; the bearer near the patient's head is the rear bearer.

"If the bearers have to carry the stretcher up hill, the front bearer should support the end of the stretcher on which the patient's head is placed, excepting under the following circumstances:

"If the bearers have to carry the stretcher down hill, the rear bearer, or No. 2, should support the end on which the patient's head is placed. The reverse position should be assumed by the bearers both as regards going up hill and going down hill, in case the patient being carried is suffering from a recent fracture of the thigh or leg.

"The patient's comfort and welfare will be best consulted as a general principle by the arrangements made in the two last paragraphs. Although under all circumstances the level position should be sought for as much as possible, still, if the slope of the ground be such that it cannot be attained, it appears desirable that the inclination downwards should be towards the feet rather than towards the head of the patient. But with regard to the exceptions named, a reverse position of the patient is directed in order to prevent the weight of his body pushing the upper end of the broken bone down upon the helpless and motionless portion of the limb below the seat of the fracture.

"No attempt must be made to carry a helpless patient over a high fence or wall, if it can possibly be avoided; it is always a dangerous proceeding. The danger is of course increased in proportion to the height of the wall or fence. If the fence or wall be high, either a portion of the wall should be thrown down, or a breach in the fence made, so that the patient may be carried through on a stretcher; or the patient should be carried to a place where a gate or opening does already exist.

"In crossing a ditch, dyke, or hollow, the stretcher should be first laid on the ground near its edge. The first bearer then descends. The stretcher with the patient upon it is afterwards advanced, the first bearer in the ditch supporting the front of the stretcher, while its other end rests on the edge of the ground above. While thus supported the second bearer descends. The two bearers now lift the stretcher to the opposite side, and the fore part being now made to rest on the edge of the ground while the rear part is supported by the second bearer in the ditch, the first bearer is left free to climb up. The stretcher is now pushed or lifted forward on the ground above, and rests there while the second bearer climbs up. The two bearers then carry the stretcher on.

"On no account should a stretcher be permitted to be carried on the shoulders of two or four bearers. The evil of such a proceeding is not only that it is difficult to find several bearers of precisely the same height, so that a level position may be secured, but also that the wounded or sick person, if he should happen to fall from such a height, owing to the helpless condition in which such a patient usually is, is not unlikely to sustain a serious aggravation of the injuries he may already be suffering from. Moreover, one of the bearers of the stretcher ought always to have his patient in view, so as to be aware of hæmorrhage, fainting, or other changes requiring attention, taking place, and this cannot be done when the patient is carried on the shoulders.

"If the wounded man lying upon a stretcher have to be transferred into an ambulance wagon, a third bearer should invariably be employed to assist in the proceeding."

There are occasions when a sufficient number of stretchers, either

"ambulance" or "hospital," may not be at hand; it will then be necessary to adapt oneself to circumstances, and take advantage of such means as may be present. If near, shipping hammocks and cots may be converted into stretchers by being suspended from single poles, as represented in figs. 1 and 2, or by a little management they can be arranged to be carried between two poles. The former means were adopted during the late expedition of British troops in Western Africa.

"Blankets, by having a loop sewn at each corner, can with two poles or two rifles make temporary conveyances. A loop should be sewn at each corner, and the blanket be then doubled over so that the two loops at each

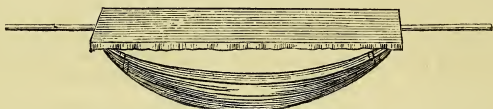


Fig. 1.



Fig. 2.

Hammocks and Cots used during the Ashantee War, 1873-74, arranged with shades for protection from the sun. (From drawings by Surgeon J. Fleming.)

end are brought together, a pole or rifle can be passed through the four loops on one side, and another passed within the doubling of the blanket on the other side.

"In urgent cases a blanket may be used as a means of carriage by four men, one taking hold of each corner. It must first be spread out upon the ground, and the patient laid gently on it in a suitable direction."

*Extemporary Transport.*—The following stretchers may be constructed on the spot from materials generally available. Fig. 3 represents a very simple one made with two long poles and two shorter ones laid cross-wise and nailed, or secured by tying, strong cloth, linen, or any other material being stretched across. Boards may be substituted for the cloth, in which

case a sack filled with straw, hay, or other soft material must be laid across. Fig. 4 represents a stretcher composed of two long poles of equal length, with two or three of the men's belts interlaced. Two cross poles would, of course, keep the long ones apart, and make the contrivance more comfortable, but heavy. Fig. 5 represents a stretcher constructed with a hay or straw rope, which, though troublesome to construct, and requiring experts

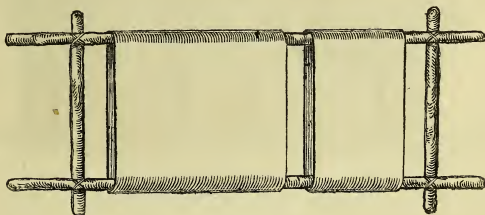


Fig. 3.

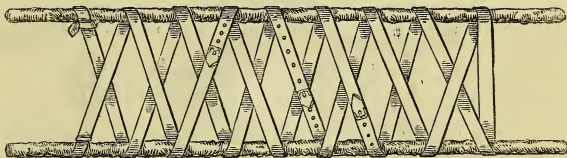


Fig. 4.

at the manufacture of the rope, might be found convenient if circumstances admitted of its being made.

Many plans have been devised from time to time for converting men's great coats or tunics, and rifles, into temporary means of conveyance, sufficient in an emergency to carry a wounded soldier from an advanced post to the first line of surgical assistance. Fig. 6 represents a stretcher constructed with four rifles and two great coats. Two rifles are firmly lashed together by their barrels, so as to take the place of poles. The sleeves of the coats are then turned into the inside of the garments, and the

rifles passed through them, after which each coat is buttoned down the front in the usual way. With one tunic or coat, and two rifles, a short stretcher may be constructed, as shown in figs. 7 and 8, which would answer for a wounded soldier unable to walk, but capable of sitting up,

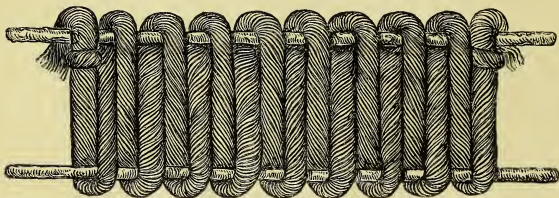


Fig. 5.

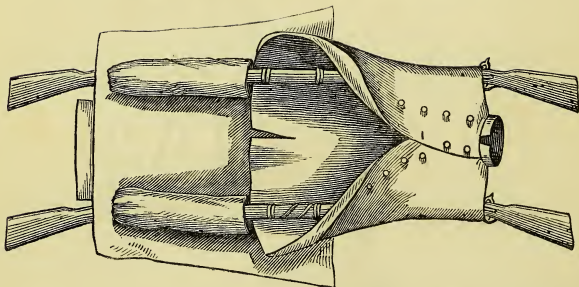


Fig. 6.

his back being placed against front bearer, and his legs hanging down in front of rear bearer.

*Country Carts.*—When sufficient wheeled carriage or transport suited for wounded is not available, country carts may be adapted for the purpose by a few simple arrangements.



1. If materials are procurable a stretcher may be constructed with ropes, (fig. 9), straw, hay, or leather belts, and slung within from the sides of the cart, care being taken that the lashings are well secured, but not too tight or too loose; in the former case, the stretcher would receive the impulse from the body of the cart, and in the latter, it would knock against its sides.

2. Should means for constructing a stretcher not be at hand, the cart may

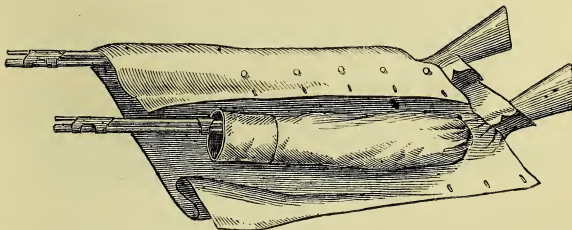


Fig. 7.

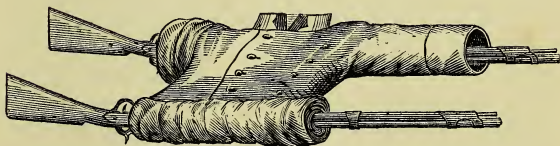


Fig. 8.

be filled with small branches of trees evenly placed, and over them a thick layer of straw, hay, rushes, ferns, or any soft material on which the sufferer may be laid.

3. A large quantity of fresh straw evenly laid in a cart will form a moderately comfortable conveyance on which wounded men may be carried for a considerable distance without any ill effects. In India, it is not uncommon to place a dooley on a country cart filled with straw, when bearers are not procurable. Dr. Appia suggests that an extempore litter may be



made by shirts found in the haversacks. The poles are to be inserted into the shirt, and a number placed one above the other. There may be some doubt, he says, about the solidity of a litter of this kind, and before placing the patient upon it, it should be tried by a soldier to insure all being in proper order, for nothing can be more distressing than to see a litter break down, or bend under the weight of a wounded and suffering man. A good-sized ladder also serves very well as a litter.

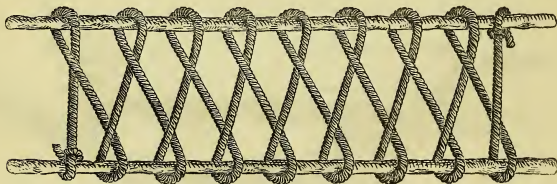


Fig. 9.

*Cacolets* are only suited for patients in sitting postures. Dr. Appia\* remarks, with reference to the cacolet *with rests*, that it is very rarely of use even in wounds of the trunk, of an arm, or almost of the foot; but that it is impracticable in wounds of the abdomen, in fractures of the thigh, wounds of the knee, and compound fractures of the leg. In cases such as these, the cacolet *bed* has rendered excellent service. In order to prevent the shaking as much as possible, it is desirable to make the patient sit or lie, upon very pliant cushions, and for this purpose he recommends those made of india-rubber, which he has frequently made use of.

Cavalry lances have been recommended, for forming the side poles of extemporary stretchers; but they will scarcely bear a weight of 10 stone, and are too elastic.

Soldiers' knapsacks are capable of being used in the formation of stretchers, by being fastened with their straps between poles or rifles, as represented in fig. 10.

Mr. Hamilton of the U. S. A., in writing of blanket litters, recommends "cedar as being the best, being light, elastic, and strong. Next to these, pine or ash. Two cross-bars are sufficient. The blanket may be rolled in before the cross-bars are made fast, or, the cross-bars being first secured, the blanket may be 'knotted up' by strings, and, if strings cannot

\* 'The Ambulance Surgeon,' by P. L. Appia, M.D.

otherwise be procured, they may be made by tearing strips from the margin of the blanket.

"Oat or corn sacks will serve as a canvas bottom to a temporary litter, or, in an emergency, any old pieces of cloth—the fragment of a tent, an overcoat, or even a pair of pantaloons ; some of which things can almost always be found on a battle-field. Litters thus constructed make excellent beds also in a hospital tent, when placed upon four crotched sticks driven into the ground."

General Jackson recommended, and adopted occasionally, a very simple method of conveying the sick, in his expedition against the Indians, viz., to

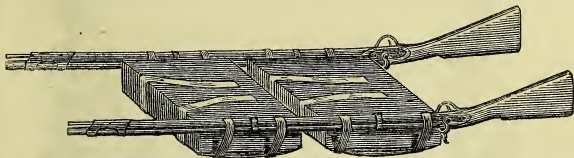


Fig. 10.

suspend a bull's hide between two muskets, upon which the patient was carried by two or four men, as the case might require.

Dr. G. Suckley, U.S.V., says, "that he has occasionally in frontier service constructed a temporary litter of two poles cut from the forest ; these being laid upon the edges of a blanket, rolled in, and finally made fast with strong twine, by puncturing the blanket at intervals of a foot along the sides of the poles, and tying the twine strongly on the outside."\*

Galton recommends a temporary stretcher to be constructed in the following manner: "Cut two stout poles, each eight feet long, to make its two sides, and three other cross-bars of two and a half feet each, to be lashed to them. Then, supporting this ladder-shaped framework over the sick man as he lies in his blanket, knot the blanket well to it, and so carry him off palanquin-fashion, as represented in fig. 11.

"One cross-bar will be just behind his head, another in front of his feet ; the middle one will cross his stomach and keep him from falling out, and there will remain two stout handles for the carriers to lay hold of. A kind of waggon-top can easily be made to it with bent boughs and one spare blanket."†

\* 'Hamilton's Military Surgery,' pp. 155, 159.

† 'Galton's Art of Travel,' p. 108.

Surgeon-Major 'Manly, V.C., has described to me an extemporised arrangement for adding to comfort of sick when transporting them, which he used in New Zealand. Each drag (a two-wheeled cart) took two wounded. Two hospital bed-cases were filled with fresh fern and placed in the drag, and two wounded men placed on them. If the wound was of the upper extremity or through the chest, more ferns were placed under the bed-case so as to raise the front half of it, by which means the man could



Fig. 11.

sit in the recumbent position; if of the lower extremities, the other half of the bed was also raised, so as to elevate the legs and thighs above the body. This was found a very good position for amputation of legs or thighs; by these arrangements and proper distribution of sick, that is, a slightly-wounded man placed alongside one badly wounded, marches of 20 and 25 miles were made with comparative comfort.

There are, no doubt, many other extemporary means of transport for sick and wounded besides what I have endeavoured to describe, but a good deal will always depend upon the nature of materials available for constructing and surgeon's ingenuity in adapting.

*For the embarking or disembarking of sick or wounded, where stretcher*

conveyance is not available or cannot be used, Doctor J. D. Macdonald, F.R.S. R.N., has designed an "Ambulance lift for ship or shore," (fig. 12); it appears to be admirably adapted for the purpose. The ham-piece (5 b) is well placed and would give great support where there are injuries of the lower extremities.

*In making preparations for the Field* compactness should be the first consideration. The object in view being to dispense with luxuries as far as possible and carry on the duties with the least amount of incumbrance, or in other words, have as little impedimenta as circumstances will permit.

It is quite surprising how on active service an ingenious surgeon will take advantage of the most trifling circumstance, and how soon he discovers he can do without many things which in peace time he would have looked upon as indispensable.

*Accompanying Troops into Action.*—The surgeon should not be hampered with too many things about his own person. What I have generally found most convenient are as follows:—Pocket case of instruments well furnished with silk, needles, &c., carried in the pouch of the cross-belt; and in a soldier's haversack or small black leather bag, a small supply of lint, two or three bandages, tourniquet, a flask of wine or brandy, and a hypodermic injection syringe, with a small phial containing two or three drachms of solution of morphia. If mounted, the surgeon can of course carry many necessaries in holster wallets. With these he can commence affording relief to any wounded. An orderly should be in close attendance, with a further supply, which may be carried in a knapsack \* adapted to the purpose, and which should contain flannel and calico bandages, lint, charpie, splints such as can be adapted for long or short bones, plaster of Paris, a metal spoon, oil or spermaceti ointment, tincture of the perchloride of iron, chloroform, sponges, candles, tourniquets, tincture of opium or solution of morphia, a drinking cup, matches, tow, essence of beef, a pencil and diagnosing cards; but, above all, he should have a large flask of fresh water. These can be replenished from the hospital panniers, which should be kept well out of fire, but easily communicated with.

*The First Line of Surgical Assistance* will in all probability be established where the first wounded man is dressed, a nucleus being formed, to which those who can move will find their way, others being carried. It may, however, be necessary to shift position for better shelter, fuel, or water; and this should be done as soon as possible, as once wounded begin to drop in they may become too numerous to move without great trouble and inconvenience. Of course, when an army is on the march and constantly engaging an enemy, assistance to the wounded must be given as they are met by surgeons advancing.

\* In the German army a hospital attendant carries a knapsack containing supplies of articles likely to be required.

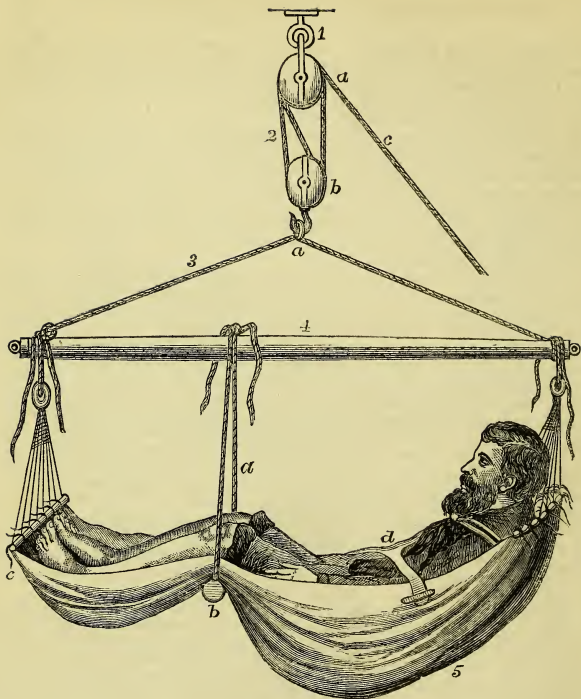


Fig. 12.

AMBULANCE LIFT FOR SHIP OR SHORE.

*References to the Figure.*

1. Hook or eye bolt fixed to the beam over the hatchway.
2. A "double whip," or a purchase with a double block above and a single one below, *a* and *b*; *c*, the hauling part.

*The Second Line of Surgical Assistance* will be some distance in rear. The wounded will be brought thence by wheeled transports, when a permanent hospital may be established where primary operations may be performed, or such wounded as can bear the journey may be transferred to other hospitals further in rear. It is difficult to lay down any decided plan as to where wounded should be treated or hospitals established after an engagement, as the positions of towns, villages, farm-houses, with regard to the battle-field will alter any preconceived ideas or arrangements.

The want of fuel and water is a most serious matter where wounded are concerned, even more so than shelter; but where there are houses, fuel and water are sure to be found. The importance of looking out for both must be apparent, and in open countries of securing dwelling-houses, barns, stables, and outhouses for the protection and comfort of the wounded. In towns large buildings, such as churches and public establishments, may be made use of for collecting the wounded for immediate relief; after which it is better to distribute them into smaller buildings. At sieges wounded should receive their first dressings in the trenches, from whence they should be conveyed to temporary hospitals close by, where primary operations can be performed, and such wounded as are found in a condition to move sent on to the field hospitals for more permanent treatment.

*The Duties of the Surgeon at the First Line of Surgical Assistance* should be entirely confined to staunching of hæmorrhage, applying first dressings, administering restoratives, and placing fractured limbs in such position and with such contrivances that they will not be further injured by transport. He should also, as far as possible, endeavour to ascertain the nature of wounds in connection with bones; if they are split or splintered, and to what extent; if joints have been opened into; if, in injuries of the head, they are only scalp wounds, or accompanied by fracture with or without depression; if in chest wounds, whether they are external, or extending to the cavity of the thorax; and if in the abdomen, whether they are perforating or not—if the former, the condition of bowels and viscera.

He should write in a few words the conditions found on the "tablet" or "diagnosing card," which should be in general use in all armies for attaching to each wounded soldier, and which might either be worn by

3. A "span" with an eye in the middle for the lower hook of the purchase.

4. A pole  $4\frac{1}{2}$  feet long, with which the span is connected.

5. An ordinary hammock attached by the head and foot clews to the extremities of the pole, and further sustained by lanyards, *a*, fixed to a ham-piece, *b*, besides which a strengthening foot piece, *c*, is retained in its place by the foot clews of the hammock, and greater security is given to the patient by the strap and toggle, *d*, holding the sides of the hammock together. The ham-piece, *5 b*, is tightly secured to the hammock to prevent displacement.



him from the time he enters on service in the field, or be carried with the hospital and distributed by the surgeon as required. The former plan would no doubt be the best, as there would be more certainty of the cards, or at least some of them, being present ; whereas, if kept with the hospital, they may not be available when required. The information recorded on these cards is of the greatest importance, preventing much suffering and delay when the wounded reach the position where operative measures are to be adopted, the surgeon there being able to ascertain information regarding condition of wound from attached card, without exposing the patient to further suffering.

Operations, such as amputation or excision, should not be performed at the first line of surgical assistance ; not but that, if they could be done, they might be attended with greater success than at a later period, but they would take up too much of the time of the surgeon, while other wounded would be obliged to do without aid. On this point Pirogoff, the distinguished Russian surgeon, has made some valuable remarks. He says : " Surgical work done in the heat of battle is but waste of power, and scarcely less useless than the feverish practice of the bandage places ;" discrediting the value of the operations done in the heat of battle he adds, as a further reason why they should not be attempted, " that the rapid firing of recent weapons produces such a simultaneous crowd of wounded that ambulances are immediately thronged, and reliable diagnosis between the cases suitable to operation and for conservative surgery rendered impossible. He, therefore, assigns to the surgeon at the bandage places the duty of using means to avert danger, of transmitting the wounded ticketed with diagnosis cards to prevent all further painful and unnecessary examination, and of dividing the wounded into ' those hopelessly injured, those requiring prompt attention, those fit for transport, and the slightly wounded.' " Professor Billroth, of Vienna, is of the same opinion.

*After an Engagement with the Enemy.*—An engagement having taken place, the surgeon in advance is called upon to attend the wounded ; he will have many points to consider as each man comes before him, and these must be rapidly turned over in his mind, and as quickly acted upon. There may be violent hæmorrhage, extreme constitutional alarm, or what is generally known as " shock," pain, insensibility, fracture, laceration of soft parts, or internal injury of some kind.

Surrounded by a great number of wounded, the surgeon may feel puzzled to know what condition he should relieve first.

*Wounded to be first relieved.*—In all probability he will have to afford assistance as he meets the wounded, or as they are brought to him ; but should he be in a position to make a selection, those suffering from hæmorrhage should be his first consideration, while those otherwise wounded should have warm drinks or stimulants administered, and with consolation



and a few kind words they will be in a more comfortable position and better able to bear the pain of having their wounds dressed when their turn comes.

The expedients for arresting hæmorrhage are considered under the subject "*Hæmorrhage*."

Constitutional alarm or shock is best relieved by the administration of cordials, stimulants, tea, or beef tea.

*The Pain of a Gun-shot Wound* is sometimes excruciating, especially when a large nerve has been wounded or the weather is very cold. Heretofore it was the custom to administer opium internally in some form or another; but the use of morphia in solution given in the form of a hypodermic injection has been found to afford such speedy relief, so convenient of administration, and so portable, that it is now generally used in warfare. The solution is best made with distilled water in proportion of one grain to 24 minims. Six minims for one injection.

During the late Franco-German war some of the British ambulances used the hypodermic injection of morphia with most happy results.

*Hypodermic Syringes*.—The points of the ordinary hypodermic syringes are somewhat like a grooved needle, and are difficult to introduce; it is therefore recommended that in making a selection of these invaluable instruments the point be flattened, like the point of a lancet, which requires very little force for introduction.

Urgent cases having been attended to, the surgeon will proceed to put up fractures, which will require much skill and care. He can then afford aid to the more lightly wounded, who, in all probability, will require little more than a piece of wet lint or charpie, secured by a bandage or roller.

Of the lightly wounded there will be about two-thirds of the whole.

*The insufficient supply of Bandages* is generally much felt after engagements, as it is impossible for the surgeon or his attendants to have at hand a number equal to the necessity of the occasion; and though a supply may have been provided, they will very likely not be forthcoming when required. During the latter part of the Crimean war, and the war in New Zealand, the English troops were furnished when going into action with a strip of bandage 4 ft. by 3 in., a piece of lint 12 by 3 inches, and 4 pins, which they carried in their packs. This arrangement I do not approve of, as a soldier may be separated from his pack.

*Esmarch Bandage*.—Professor Esmarch has designed a triangular bandage (fig. 13), which can be applied in thirty-two different ways. It measures 4 ft. at its base by 2 ft. 10 in. It can be folded flat, and therefore takes up but little space. The bandage is inclosed in a waterproof envelope, which protects it, and no doubt would be found useful as part of the dressing.

*Each Soldier to be provided with a Bandage*.—I have long been of

opinion that each soldier going on active service should be provided with one of these bandages, or a strip of bandage and piece of lint; that a certain position in a soldier's tunic should be selected in which this bandage might be deposited, so that the man himself, the surgeon, his attendant or comrade might know exactly where to find it. Much inconvenience and suffering would then be avoided.

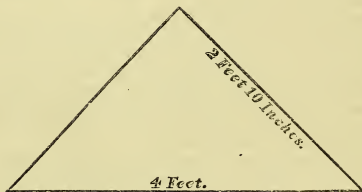


Fig. 13.

*Gun-shot Fractures*, especially of the lower extremities, are always sources of great anxiety on the field of battle, as the sufferer must, as a rule, undergo transport, and unless the limb or limbs are securely "put up," even in a temporary manner, the consequences will be most serious, often rendering slight injuries severe and complicated.

*Extemporaneous Appliances.*—It is not always possible to have at hand special splints, plaster of Paris, or any of the numerous contrivances for securing fractures; the surgeon will, in consequence, frequently be obliged to make use of such expedients as circumstances will admit of, or, in other words, improvise splints from materials generally available on the field of battle. For this purpose, in a case of *fracture of the thigh*, a rifle may be placed along the outside of the limb (fig. 14), extending from the axilla to the foot. It should be secured by a bandage round the trunk, and by another round the foot and ankle; a soldier's great coat or cape should then be folded, so as to partially surround the limb and the rifle, the whole being secured by means of the straps of the great coat, bandages or anything suited for the purpose. The butt end of the rifle should be placed in the axilla.

Another plan for putting up a fractured thigh is with two long splints, one reaching from the hip to the heel, and the other from the perineum to the heel, a third short one being placed in front, and the whole secured by straps, handkerchiefs, or bandages (fig. 15). Both feet should be tied together.

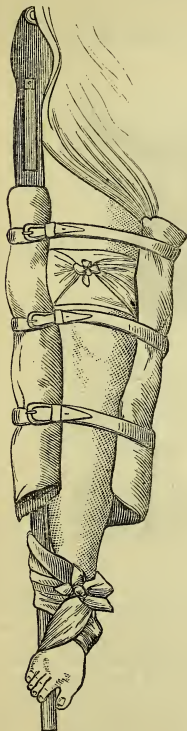


Fig. 14.

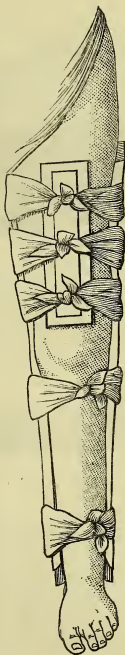


Fig. 15.

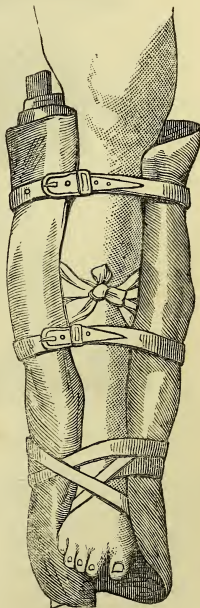


Fig. 16.

For *Fractures of the Leg*, the following extemporary splints may be constructed with very little trouble. Fig. 16 is intended to represent a

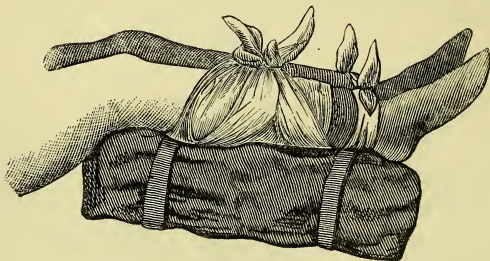


Fig. 17.

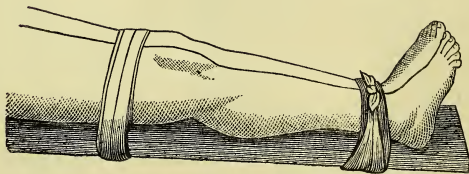


Fig. 18.

fracture of the leg secured with a splint placed along the outside of the limb, and the whole rolled in a great coat or cape fastened by straps or pieces of bandage.

Figs. 17 and 18 speak for themselves. In one the legs are tied together at the ankles and placed on a soldier's knapsack, and in the other the legs are also tied together, but they are placed on a board. In securing limbs in such positions some soft material should be placed underneath them and in between, so as to fill up spaces and make the parts comfortable. If nothing better can be found hay or straw will answer.

A fractured leg may easily be put up with the scabbard of a sword and a board, as represented in fig. 19.

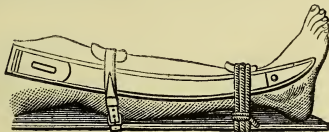


Fig. 19.

A roll of straw makes a capital temporary splint placed along the outside of the limbs, as shown in fig. 20.

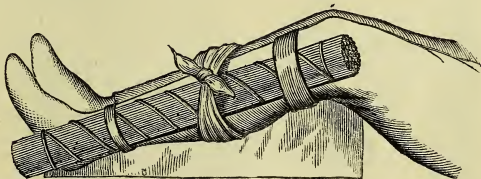


Fig. 20.

When a piece of cloth and two rolls of straw are available a most comfortable splint may be constructed by placing the limb in the centre of the cloth, and rolling bundles of straw of equal thickness (and the length of the limb) until they come in contact with the fractured member (fig. 21).

*Fractures of the Arm* may be "put up" with very thin bundles of straw lined with cotton wool or wadding, or they may be enveloped in straw, in which case it is of course necessary to have a soft lining.

Fig. 22 represents a fracture of the upper arm "put up" with a bayonet and its scabbard, which, if nothing better can be found, will prevent the limb from being further damaged in transport.

Should thin pieces of board be available, such as the lining boards of a soldier's knapsack, they may be applied as represented in fig. 23. The forearm being flexed, one splint is placed on the inside of the arm, reaching from the axilla to the inner condyle; a second long splint is placed

on the outside of the arm, reaching from the acromion to the external condyle, and a third may be placed on the front or behind ; these may be secured by straps or bandages. The forearm should be supported with a sling.



Fig. 21.



Fig. 22.

*Fractures of the lower end of Humerus* are best secured with an inside rectangular splint, the straight splint not giving sufficient support.

*Fractures of the Fore-arm* may be put up with two light splints, one placed in front and the other behind, and as a temporary contrivance the splints may extend beyond the fingers, so as to give perfect support to the hand and wrist during transport. On arrival at a permanent hospital, or any place where proper splints are procurable, the temporary ones should be replaced by such as are in use and recommended for particular fractures.

It has always been a special point in preparing surgical appliances for war to provide splints of materials which will be sufficiently strong to support the largest bones when fractured or shattered ; at the same time be light, easily carried, and capable of being applied with facility.

The old-fashioned *scored splints* were at one time much used, but they were liable to be rendered unserviceable by exposure to wet or from the moisture of wounds, and have consequently fallen into disfavour.

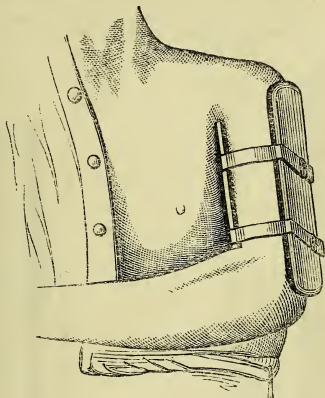


Fig. 23.

*Wire or trough splints.*—The French have introduced splints made of wire, which are very strong but somewhat cumbersome; they are formed to the shape of the limbs for which they are intended, those for large limbs being composed of a stronger description of wire than those for smaller, and having the general appearance of splint represented in fig. 24.

*Wooden or gauze splints.*—The German army surgeons are provided with strips of thin metal gauze, and thin pieces of wood, but little thicker than veneer, which substances are very light, easily carried, and take up small space in the hospital knapsack.

Thin sheets of perforated zinc, or tin, gutta percha, leather, cane, whale-bone, and various other materials, have been proposed, so important and necessary is it that some kind of splint should reach the field of battle and be ready for immediate application.\*

\* Hospital stretchers are now contrived so as to carry a set of splints.



*Duncan splint.*—Duncan has designed a splint known as the “*rattan splint* :” it is composed of cane or small rattan, strung as it were together and cut to certain lengths ; each end is covered with a cap of cloth to prevent splitting or the rough ends irritating : they are very light, but rather bulky, presenting the appearance without caps, as shown in fig. 25.

A modification of this splint has been made by covering the cane with

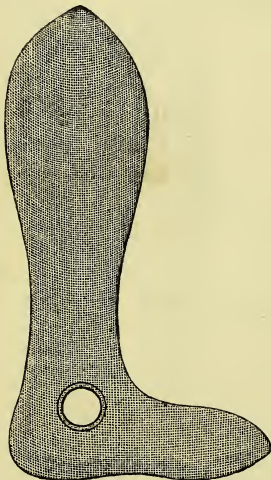


Fig. 24.

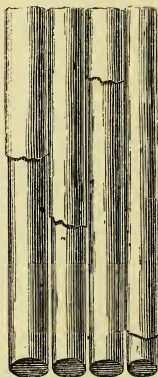


Fig. 25.

canvas and attaching three straps and buckles, or as many as may be considered necessary for the size of the splint ; this makes the splint more bulky than Duncan's.

*Wyatt's splint.*—Surgeon-Major Wyatt has designed a splint for field purposes which in appearance resembles an ornamental cover for a flower-pot. It is capable of expanding to a very great extent, and therefore can be made use of for any limb, no matter how large its circumference may



be. He proposes enveloping the fractured limb with it, filling spaces and irregularities with carded oakum, and securing the whole with three straps and buckles (figs. 26, 27).



Fig. 26.—Wyatt's  
Splint folded up.

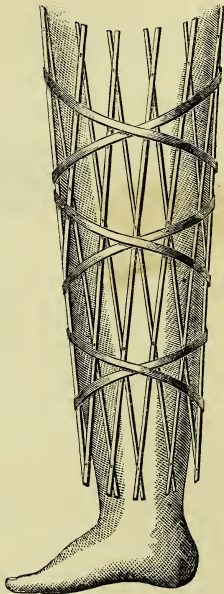


Fig. 27.

Deputy Surgeon-General Gordon records an ingenious adaptation of extemporised wooden splints: "Cotton-wool being placed as a cushion upon the splint, it is then applied, a series of silicate of potash bandages at

intervals securing the whole in such a way as to render the divided ends of fractured bones quite immovable. The wound itself is left uncovered by the splints, openings being left in them for the purpose.”\*

*Extemporary pads and cushions.*—The army surgeon may at times be under difficulties as regards the construction of pads or cushions; they may, however, be made with cotton-wool, tow, oakum, chaff, shavings of cork or horn, cut straw, hair, cut paper, feathers, dried sea-weed, bran, and saw-dust.

For temporary splints the writer has made use of laths, switches, rushes, reeds, straw, brushwood, arranged as represented in fig. 28, heather, leather



Fig. 28.

straps, such as a trace or stirrup leather, strips of tin. There is very little difficulty in converting the many articles found about a house, farm-yard, or in fields, into temporary splints, but even with the best and most perfect, which will answer for use in permanent hospitals, there are some fractures in which it is almost impossible to keep the broken ends of the bones in position during transport.

*Plaster of Paris* has been much used of late years for securing fractures on the field, and though its preparation causes great delay, still the results have been highly satisfactory, and many plans have been proposed for its application. Billroth remarks on this subject: “I consider the treatment of gunshot fractures by fenestrated plaster-bandages as the only proper method (excepting perhaps those in the upper part of the arm or thigh); the only thing against it is that surgeons who have not already treated open fractures with plaster dressings, and are not adepts in the application, should not make their first experiments on gunshot-fractures, but should only apply dressings with which they are familiar.”

*Pirogoff*, who claims priority of the invention, gives the following account of the process for its application: “A drainage-tube is drawn through the wound, which is either covered with charpie or united by sutures, a roller of flannel, cotton, or other rough texture is applied over the entire limb, and on this the plaster of Paris is smeared; a large piece of wire gauze is then taken, an aperture corresponding to the size and position of the wound cut out, and with the remainder the limb is closely enveloped. Plaster of Paris

\* ‘Lessons in Hygiene and Surgery,’ by Gordon, p. 128.

paste is again laid on, and finally the whole is fixed by one or more layers of paste bandage, additional turns being given in the vicinity of the fenestra, if extra strength is required. When the material has fully hardened, the fenestra is opened through the parted bandage by means of a strong scalpel. The plaster of Paris bandage may be put on either at the bandage place preparatory to transport or subsequently in the hospital for the purpose of treatment; in the former case without fenestra, providing the distance to be accomplished is not too great, and that the appliance can be removed on arrival. Pirogoff does not delay its application on account of inflammatory swelling, but he slits the bandage up the whole length, and so converts it into a case out of which the limb can be taken and cleaned when required. When the swelling subsides the ordinary plaster of Paris bandage must be substituted. He lays down the fundamental advantages of the appliance as follows: "That it exercises a uniform circular pressure throughout the entire length of the limb, thereby paralyzing the attacked muscles; that it secures immobility to the broken fragments; and that it keeps up continuous extension to a certain extent when put on and allowed to harden while the limb is extended.

"The firm unyielding capsule formed by this bandage when it embraces the joints above and below the wound prevents the further approximation or riding of the broken ends, and keeps the limb on the constant stretch. Finally, the fenestra in the bandage must be so arranged that the fixity of the bandage must not be lessened."\*

*Surgeon-Major Moffitt*, who has made several experiments in connection with the employment of plaster of Paris as a means of forming splints or supports to facilitate the transport of men suffering from gun-shot fractures, gives the following mode of application which he recommends.

"Plaster of Paris in a proper state, water, spermaceti ointment, a small basin and a spoon, being in readiness, a piece of flannel is to be cut, of shape and size fitted to envelope the limb, with the exception of a longitudinal space, of about half an inch in breadth, between its edges. If for the leg, it should be of the shape shown by the dotted line in the illustration (fig. 29). The limb should then be greased with spermaceti ointment, and the hairs smoothed down to the skin, or, what will be found to answer as well, if not better, a calico roller may be wound spirally round the limb, and divided at a later period, after the plaster covering is applied, along the vacant interval between its edges. The calico will not only prevent the hairs from sticking to the plaster, but will also form a neat lining for the splint. Either of these steps having been taken, equal parts of plaster of Paris and water should be quickly and thoroughly blended together by stirring, and in this mixture should be immersed, with the hands, the piece of flannel about to be used. When the flannel is well saturated, and its sur-

\* 'Medical Times and Gazette,' August, 1873.

face completely covered with plaster, it should be withdrawn from the basin, the folds and creases stretched out of it, and it should then be applied and pressed to the limb so as to fit it accurately, without, however, permitting its edges to join each other; the object of this last precaution being to leave a

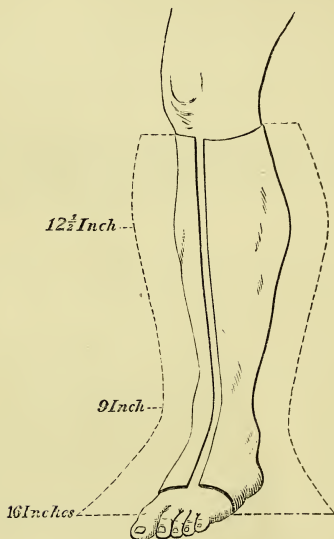


Fig. 29.

narrow open space up the whole length of the limb, to allow for the occurrence of swelling. In this position it should be held steadily until the plaster has set, which will generally not occupy longer than five minutes. The illustration shows the splint applied to the leg. Should the splint, however, after the plaster is set, be considered not to have strength and

firmness enough, another layer may be applied over it exactly in the same way. A roller may now be applied lightly over the whole.

"The quantity of plaster requisite for a leg is about eight ounces ; for the thigh and arm in proportion.

"Should it be desired, however, to make the plaster more secure, or to

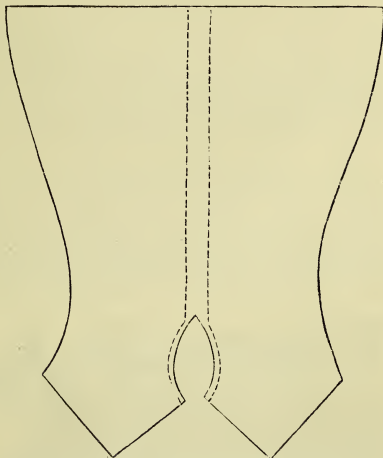


Fig. 30.\*

continue its application as a permanent splint, this may be done with great facility by the addition of a little dextrine. This will be best accomplished by taking a piece of flannel of the dimensions similar to that used for the plaster of Paris, coating one side of it over with a thick solution or paste made with the ordinary dextrine, and applying it over the plaster of Paris splint already in use."†

\* 'Lessons on Bandaging,' by Dr. Port, p. 22. Munich.

† 'Army Medical Department Reports for 1865,' p. 555.

*Neudörfer* recommends a very simple plan for the application of plaster of Paris bandages : "Compresses of linen or of lint are dipped in the plaster of Paris of the consistence of a common poultice. These are then placed longitudinally on the limb, first on the upper, then on the under part. A few turns of a bandage keep them *in situ* till the plaster is set. To prevent the contiguous edges adhering, they are lightly greased, or a slip of greased lint is put between them."\*



Fig. 31.

The mode of applying the plaster apparatus, as practised in the *Bavarian Army* during the late Franco-German war, is as follows :—"Two pieces of flannel, twenty inches broad, are stretched together for the leg, as represented in fig. 30, and stitched down the middle; and beyond this both are cut through in the same line for the length of the foot. The flannel is placed under the limb, so that the seam reaches from the ham to the heel. The sides of the inner piece are brought together over the leg and fixed in front and along the sole by pins (bent at right angles (fig. 31), so that they may be easily extracted afterwards), and thus a closely-fitting stocking is formed. The sides of the outer piece are then brought forward and cut, so that each may overlap the middle line of the leg and sole by three-quarters of an inch.

The limb is then laid on one side, and while this outer piece of flannel is held back, a layer of plaster of Paris of the consistence of thick cream is

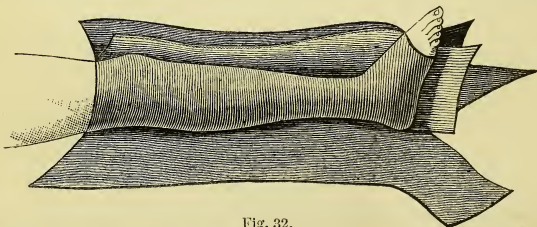


Fig. 32.

spread evenly to the thickness of half an inch over the inner piece, and made to pass quite to the seam behind, and the line of juncture of the sides of the inner piece in front. The outer piece is pressed over this before it sets, and should just reach the middle line in front and along the sole. When this has set, the limb is turned over, and the process is

\* 'Erichsen's Surgery,' vol. i., p. 287. 6th edition.

repeated on the other side (fig. 32). The pins may now be removed. The seam serves as a hinge; and when the whole has set, the splint may be taken off, the edges of the plaster trimmed, and those of the inner piece of flannel cut so as to leave sufficient to turn over and stitch down on the outer piece. The splint is then readjusted and fixed by a bandage. The setting

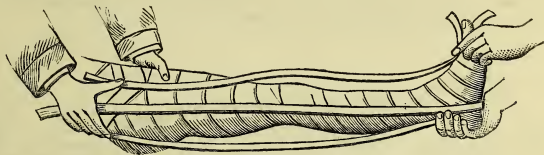


Fig. 33.

of the plaster may be retarded by the addition to it of solution of borax. Thus a solution of one part to twelve of the water used will retard the setting fifteen minutes.”\*

*Volcer* has devised a plan for applying a plaster of Paris bandage to a fractured thigh, which is as follows:—If time admits, give chloroform and keep the patient under its influence till the plaster hardens. The patient should be kept perfectly steady.

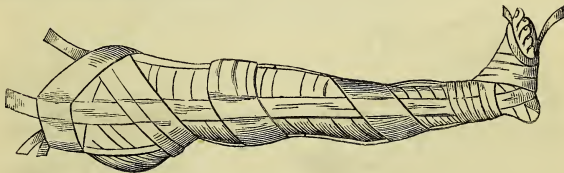


Fig. 34.

The extremities, from the toes to the haunch, must be enveloped in wadding, which is to be cut into strips four inches in width; this wadding is then to be covered with moist gauze, which keeps it in position; over this narrow strips of thin wood (fig. 33), so flexible that they can be rolled like a bandage, are to be placed on four sides of the entire length of the limb. Two attendants fix with their hands these long splints until an ordi-

\* ‘Erichsen’s Surgery,’ vol. i., p. 287. 6th edition.



nary plaster bandage, which has been dipped in water, has been placed round the limb, by means of which the splints are firmly fixed (fig. 34). Then five or six plaster bandages are used from the toes to the haunches, carrying the bandage well round the hips. Care should be taken that the plaster bandage does not extend over the wadding at the hips and abdomen, and that an orifice (fig. 35) is left for discharges and application of dressings in the event of there being a wound.

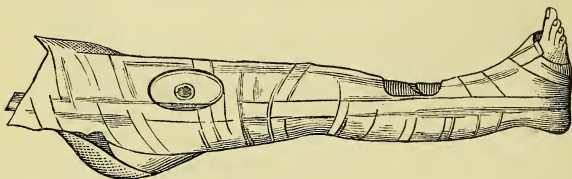


Fig. 35.

*Swinburne's Brancard.*—Deputy-Surgeon-General Gordon describes a contrivance for the carriage of a soldier suffering from fracture of the thigh, which has been designed by Doctor Swinburne. He says, by means of a common brancard, ingeniously arranged, Dr. Swinburne con-

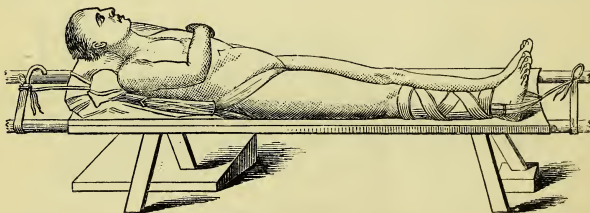


Fig. 36.

siders that a soldier or officer with gun-shot fracture of the femur can be carried with an advancing army over any extent of country. Upon one of the handles at each end a bent iron arm, having an "eye" at one end, was fixed by means of a screw. It admitted of being moved along the handle, or from one to the other, according to the seat or side of



the injury, and from those at the head and foot extension and counter extension could readily be used, as represented in fig. 36.\* This plan, as represented in illustration, the writer considers, might answer for a very short distance over a level country, but without further support to the broken bone it is doubtful whether it would answer for transporting for a considerable distance.

*Appia's Apparatus.*—Doctor P. L. Appia, impressed with the danger to reunion of transport under disadvantageous circumstances, invented and

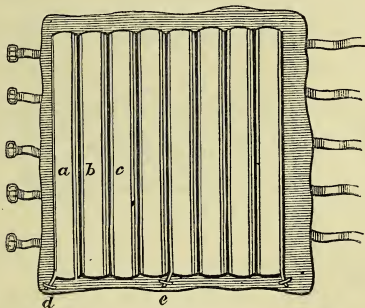


Fig. 37.

had made, that it might be tried in the war in Italy, an apparatus for fractures, which he describes as follows :—

“After having been tried in the army of Italy, this apparatus was introduced into the military hospitals of Paris and Turin, and into the Spanish army. It consists of a number of splints and vulcanized india-rubber air cushions (fig. 37, *a, b, c*). The cushions are joined together, and form one whole. At the extreme end of each cushion, or pair of cushions, there is a plug for inflating it (*d, e*).

“The splints, to the number of five, are bound in strong canvas, which serves as a covering to the cushion (fig. 38). I preferred five splints to three, the usual number, that it may entirely surround the limb, and thus ensure more entire immobility during the removal. The apparatus varies in size and number of cushions. In the simplest there are four cushions,

\* ‘Lessons in Hygiene and Surgery,’ by Dr. Gordon, C.B., p. 89.

about fifty centimetres in length to fifteen in breadth, inflated by two plugs, and five splints of the smallest size, with three straps.

"This very simple form is intended *especially* for wounds of the knee, the leg, and the foot. The other more complicated apparatus, which I am

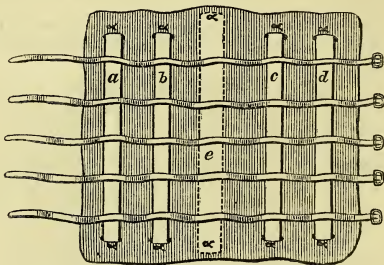


Fig. 38.

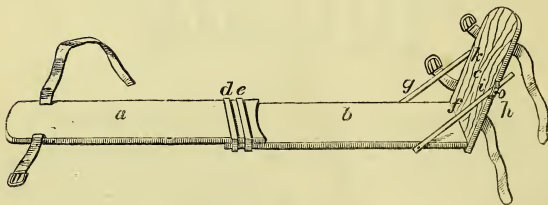


Fig. 39.

about to describe, was the object of my most careful study. It is intended for fractures of the thigh, and for complicated wounds of the knee. Here the cushions must be six or eight in number, longer and narrower than the former, seventy centimetres in length to six in breadth; they may be inflated by either of the plugs. There are five straps. But what particularly distinguishes this apparatus from the other is the long splint (fig. 39). It is composed of several pieces, intended to admit of its ex-

tension, and yet form as firm a support as if they were all one piece of wood.

The splint is composed of two half-splints and of a sole for the support of the foot (*a, b, c*); the two halves, joined together by two smooth brass rings, can slide over each other without losing their respective directions.



Fig. 40.

Upon the back of one of the boards is a series of notches (*encoche à crémaillère*) (fig. 40, *a, b, c*), into which fastens a spring or hook, fixed at the end of the other board. A very simple mechanism thus affords a firm and gradual lengthening, both being effected by simply drawing out the splint.

The foot-piece is fastened to the lower board by means of a lateral hinge,

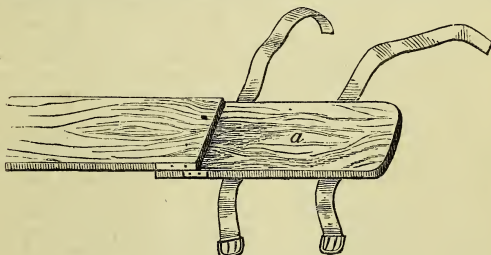


Fig. 41.

which, being firmer than an ordinary one, allows at the same time of the sole being brought down entirely (fig. 41, *a*). Two brass supports, fixed laterally (fig. 39, *g, h*), can then be detached, go into two openings formed by a metal plate, and slide into it without difficulty (*i, k*); they are stopped by a screw. The sole is, besides, furnished with canvas straps, intended

to keep the foot firm, and which are buckled to the lower surface of the boards, so as to avoid all painful pressure of the foot. A long stirrup, placed at the upper end of the splint, fastens it to the body. When this apparatus has been used it is easy to shorten the long splint by folding it up to the exact size of the other simple splints, same in the thickness, which must necessarily be double (fig. 42).



Fig. 42.

“The following is the manner of its application on a healthy body supposed to be wounded in one of the thighs:—1. The person is laid in the horizontal position. 2. The dressing is quickly opened, and spread out smoothly by the side of the thigh supposed to be wounded. 3. The long splint is drawn out in both directions to its utmost length without withdrawing it from the canvas sheath in which it is enclosed. 4. The wooden sole is lowered horizontally. 5. The whole apparatus is passed under the injured limb, so that the sole may be properly fitted to the foot, which is firmly fastened by means of the leather strap. 6. The upper end of the splint is fastened to the pelvis by the long strap. 7. After the long splint has been thus firmly applied to the limb, the assistant must stoop down and inflate the cushions successively by the plugs. This requires strength and some degree of perseverance. 8. The whole apparatus is thus drawn completely round the limb, taking care that the cushions meet in front, and all firmly fastened together by five straps; in doing so making use of the support of the left knee. This is the time when the buckles are put to the test. 9. Finally, the sound limb is firmly fastened to the wounded one. Experience has, curiously enough, proved how entirely the leg is secured in this apparatus from any shocks from without. One may even sit down upon it violently, when fixed and buckled up, without the leg experiencing anything beyond a slight increase of pressure. All shocks from without spread immediately, by the law of undulation, through all the cushions, and produce only a trifling direct effect.”

*Wounds, how Inflicted.*—Wounds inflicted in war may be produced by missiles projected by some explosive material, such as bullets, cannon shot, shrapnel, shells, grape and cannister shot, and slugs, which come under the head of gun-shot wounds. There are other wounds produced by sabre, bayonet, or lance, and indirectly by fragments of substances struck by bullets, shot or shell—such as stones, wood, metal, and even by fragments

of the bones of comrades, or by explosion of the engines of war above and below water. Arrow wounds are occasionally met with. From the depth to which wounds extend they are denominated superficial, muscular, and penetrating; and from the nature of the weapon with which they have been inflicted they are characterized as incised, punctured, lacerated, and contused. They may also be classified according to the region of the body, as, for instance, the head, face, neck, thorax, abdomen, and extremities.

*Treatment of Wounds.*—As regards the treatment of wounds, they must first be considered under the head of incised, punctured, lacerated, and contused wounds of soft parts, and then in connection with regions.

*Incised Wounds*, or such as may be produced by sword or sabre, should be carefully cleansed, all extraneous substances removed, the edges brought together, and if necessary, kept in position with adhesive plaster or sutures. And to assist in preventing the wound opening, the muscles in connection with the parts injured should be relaxed by regulating the position of the limb. The parts must be lightly dressed with lint or charpie, and kept in position with a roller.

*Punctured Wounds* (such as may be produced by a bayonet) of the soft parts, are peculiarly liable to excite inflammation in the neighbouring textures, the formation and confinement of matter under the fascia, the injury of deep-seated vessels and consequent hæmorrhage, and tetanus by lesion of a nerve.

Older surgeons were in the habit of forcibly dilating punctured wounds with a view to preventing the unpleasant consequences mentioned, being fully aware of the danger of these wounds. There is little doubt that they did not improve the condition of their patients. An improvement was then made of dilating them with the knife, and so converting them into simple incisions; but this expedient has been also abandoned, as it does not follow that inflammation or suppuration will as a necessity supervene. The practice now advocated is to keep the parts at perfect rest, and apply a roller to the limb to prevent subcutaneous oozing of blood. Pressure *should not be applied immediately over the wound*, but free exit allowed for any discharge. Should a foreign body be discovered, it may be removed, but probing in search of extraneous matter is inadmissible. In strong, healthy soldiers, when inflammation runs high, it may be necessary to place them on low diet, antimonial purgatives, and evaporating lotions applied to the affected parts, and in the event of suppuration taking place, the case must be treated as a deep-seated abscess, a free incision being made to evacuate the pus.

*Lacerated Wounds* are such as are inflicted by blunt obtuse bodies destroying to a certain extent the vitality and organization of the textures. There is usually but little hæmorrhage, but the pain may be very severe. If the wound has been from the effects of a cannon shot, the parts will present a

very ragged surface, the skin being stripped away, the tendons in all probability hanging out, bellies of torn muscles protruding, and the vessels exposed; but no hæmorrhage. These wounds are very slow in healing, in consequence of the superficial parts being disorganized; sloughing must first take place, after which the wound will heal by granulation. These wounds are particularly liable to traumatic gangrene, and in the head to erysipelas.

The parts should be carefully cleansed, and foreign bodies removed. Flaps of skin, however torn or contused, should, as a general rule, never be separated, provided they maintain any attachment to the neighbouring tissues, but be replaced in hopes that vitality is not virtually destroyed.

In simple cases of lacerated wounds the separation of the slough must be facilitated by the application of poultices, or, what will be found most convenient on service and cleanest, simple water dressings. Disinfectants must be freely used on the wound and in the neighbourhood of the patient's bed, as it is from these wounds, when many of them are collected together, that hospital diseases arise or are originated.

*Contused Wounds.*—These may be simple, requiring some evaporating lotion or stimulating liniment, and a few days' rest, to restore the injured parts to their normal condition; or the parts may be so damaged that sloughing takes place, when the injury should be treated on the same principles as in sloughing from lacerated wounds.

*Wind Balls.*—Extensive injuries to internal viscera have been inflicted without any sign of an external lesion; bones have been broken, and yet no sign on the external skin of contact with any missile. These injuries are produced by what are known as wind balls, which many authorities on gun-shot wounds have endeavoured to explain. Some consider they are produced by aerial percussion, from the mass of metal being projected through the air with great velocity; others attribute it to electricity.

Mr. Longmore considers "the true explanation of the appearance presented in those cases which were formerly called wind contusions, appears to rest in the peculiar direction, the degree of obliquity with which the missile has happened to impinge against the elastic skin, together with the relative situation of the internal organ injured to the missile and to other hard substances in the neighbourhood. The surface itself is not directly torn or cut into, because the impact of the projectile has not been sufficiently direct to effect an opening; but the parts beneath are crushed by the pressure to which they have been subjected between the combined influence of the weight and the momentum of the ball or shot on one side and of some hard resisting substance on the other. Thus, on a cannon ball passing across the abdomen, the elasticity and ready mobility of the skin may enable that structure to yield to the strain to which it is exposed, while viscera are ruptured by the projectile forcing them against the vertebral



column. So the weight of a ball passing obliquely over the fore-arm, may possibly crush the bone between itself and some hard substance against which the arm may be accidentally resting, without lesion of the interposed skin."

Wounds, whether received directly or indirectly, may be complicated by the entrance of extraneous bodies, such as portions of clothing worn by the wounded, or various articles which may have been about his person.

*How Gun-shot Wounds are Influenced.*—Gun-shot wounds may be influenced by the shape and weight of the missile, its velocity, and structure injured. For instance, a conical bullet will do more injury to a bone and soft parts than a round one of the same weight and fired at the same proportionate distance; and a hollow conical bullet will cause more damage to the soft parts, periosteum, and bone, than a solid, both being fired under the same circumstances. The position a limb may be in at the time of being struck, will influence the direction of the wound; also a very slight obstacle, such as a button, or a coin; and even a tendon in a state of tension has been known to turn the course of a *round bullet*; this is scarcely possible with the conical bullet fired at a short distance, which has such force as to pass directly through a limb, smashing all before it.

*Examination of Wounds.*—Penetrating gun-shot wounds of extremities should be examined most carefully for bullets, fragments of shells, or other extraneous bodies; and for doing this the finger will be found the most convenient and least likely to give pain; it will also most readily detect the nature of a foreign body.

The sooner this operation can be performed the better, as the wound will contract and surrounding parts inflame; so that the longer a search is delayed, the greater the suffering to the soldier, and the more difficult the operation.

The finger may not be sufficiently long to reach a bullet or other foreign body, or the wound may be too small to admit the finger, in which case a silver probe should be used, or any other probe which the surgeon may consider best suited to the circumstances of the case; but until the finger fails, no other probe should be used. On this point, Hunter remarks: "Probes should never be used but by way of satisfaction in knowing sometimes what mischief is done; we can perhaps feel if a bone is touched, or a ball is near; but when all this is known, it is an hundred to one if we can vary our practice in consequence of it. If the wound will admit of it, the finger is the best instrument; but if the wound is too small it may be enlarged by an incision through the fascia."

*In exploring for bullets*, various plans have been devised. In olden time the wounded man was actually lifted and placed in the same position he was supposed to have been in when wounded; but the educated surgeon can now picture to himself that position, and cause the finger or probe to work accordingly, without altering the position of the sufferer.

Mr. Longmore recommends the following course to be adopted when exploring with the finger:—

“The finger should be inserted slowly and steadily towards the deepest part of the wound. During its passage, the surgeon should carefully observe whether any foreign body appears to be pushed before it, or to be lying by the side of the track of the bullet, and should note any other peculiarities of the wound. He should also ascertain whether the end of the track is reached, and if this is found to be arrived at, a careful circular sweep of the finger-end will then usually settle if any, and what, foreign bodies are lodged. The surgeon should not withdraw his finger until the course the projectile has taken, the injury it has done, the complications of the wound, such as the presence of foreign bodies, and, in such a case, their kind and situation, have been decided by him; the exploration will then be completed by one operation, and a second insertion of the finger for the purpose, which is always irritating to the patient, avoided. If the finger be not sufficiently long to reach the bottom of the wound, even when the soft parts have been approximated by pressure from an opposite direction; and when the lodgment of a projectile is still suspected, or some other point of doubt remains to be solved, such as the direction the projectile has taken in the latter part of its course, we are compelled to make a further exploration by other means. Generally, a long silver probe, that can be bent if required, and that can be guided into a definite direction at the will of the surgeon, will be found to be the best substitute for the finger. The probe should be used with great discretion, for, without care, it may readily be made to inflict injury on vessels and other structures which have escaped from direct contact with the ball, but have returned by their elasticity to the situation from which they had been pushed or drawn aside during its passage.

“Sometimes, when the finger in the wound fails to find a lodged projectile, the particular spot in which it is lying may be detected simply by relaxing the muscular tissues, so as to give a loose and pendulous condition to the parts concerned, and then lightly tossing up the flesh at different points from below with the tips of the fingers. A bullet lodged among the soft parts will occasionally make its presence known under such an action by the impulse which its weight communicates to the top of one of the fingers when the parts, having been shaken upwards, return to their previous position. Sometimes a gentle kneading pressure in the neighbourhood of the injury, assisted by information derived from the sensation of the patient, will lead to the detection of such a foreign body; or it may be discovered by passing the palm of the hand down a limb.

“Cases in which the exploration by the surgeon’s finger is altogether impracticable, and in which the use of the probe is attended with so many sources of doubt as to prevent any satisfactory conclusion in respect to the



lodgment or absence of foreign bodies from being arrived at, occasionally occur." Much trouble and inconvenience will then be experienced unless the surgeon is in possession of some of the new contrivances for clearing up these doubts.

*Nélaton's Probe.*—M. Nélaton designed a probe for ascertaining the nature of the foreign body impacted in the bone of one of General Garibaldi's ankles. "It consists of a slender rod of metal five or six inches in length, terminated at one end by a small knob of white, unglazed biscuit china. The other end of the probe is furnished with a small handle, grooved ridge-and-furrow fashion, in order that the finger and thumb may the more easily roll it between them, while the porcelain knob is being pressed at the bottom of the wound against the suspected foreign body (fig. 43). If it be a leaden bullet against which the porcelain is rubbed, a very distinct mark of lead is impressed on the latter, which is not easily obliterated."\*

This probe of M. Nélaton's may possibly deceive the surgeon, if he supposes, because no dark mark has been produced on the biscuit china, that consequently there is no bullet, as in the event of there being anything—such as pieces of cloth, paper, linen, membrane—between it and the probe, there will be no leaden mark.

*Lecomte's Probe.*—Dr. Lecomte has designed an instrument (fig. 44) with a view to obviate the difficulties experienced with Nélaton's probe, which not only indicates the presence of lead, but by bringing away a small portion of anything capable of being cut into, declares what it is. He has given it the name of the "Probe Nippers" ("Stylet Pince"). It consists of two fine steel blades enclosed in a canula; each blade terminates in a little cup, and when both are brought together they form a small knob. These blades are in connection with a rod and handle worked by a screw. When the knob of the probe is brought into contact with the extraneous substance it is caused to open, and then, by pressure against it and causing the little blades to close,



Fig. 43.



Fig. 44.

\* 'British Medical Journal,' 1871.

a small portion is carried away. Several instruments have been designed for detecting lead and other metallic substances by means of electricity.

*Tailor's Explorer.*—Mr. Tailor's electric explorer consists of two insulated needles. They are connected by wires with a small galvanic battery and mariner's compass. When the points of the needles touch the metallic substance the needle of the compass is deflected.

*De Wilde's Explorer.*—Mr. De Wilde has adapted a telegraph bell to the electric apparatus, which denotes the presence of metal by the sounding of the bell.

*Liebreick's Explorer.*—Liebreick has designed an instrument somewhat similar to Tailor's, except that a galvanometer is substituted for the mariner's compass, the needle of which is deflected on the electric circle being completed.

Professor Longmore exhibits to his class (R. V. Hospital, Netley) an easily made electric instrument (fig. 45), and so portable that it can be carried about the person of the surgeon. He describes it as follows:—The magnet of an ordinary pocket compass, which has had some turns of wire covered with thread wound round it as an induction coil, is employed for the electric indicator, while a piece of zinc sheeting bent round a small plate of copper, but separated from it by flannel padding saturated with the usual diluted acids, forms the voltaic pile. The exploring instrument is formed by two insulated wires bound together, but the points left free. These parts being connected, when the circuit is completed by contact with metal, the indication is given by movement of the magnet of the compass.

*Extraction of Bullets.*—For the extraction of bullets, fragments of shells, or other extraneous matters, various instruments have been devised. Coxeter's extractor has been found most useful for this purpose. Also a long and strong forceps with spoon-like blades, into which a bullet is supposed to slip. There is also the "tire-fond screw," and Luers' sharp-pointed forceps; and innumerable forceps designed to suit the fancies of military surgeons. None of these can be applied without careful manipulation by the surgeon, who with his finger may be able to direct the end of the forceps towards the lodged missile, or with the hand on the outside of the limb press the bullet towards the instrument.

Bullets found near the skin, which have not had sufficient force to make an exit, require much care in removing, especially in the neighbourhood of a cavity, as by injudicious handling they may be pressed back into the cavity. It is therefore always best to fix the substance to be removed before using the knife, the incision made being free.

Bullets lodged in bone, which frequently happens in the spongy ends of some without causing fracture, should be cut down upon and removed. If superficially lodged, the steel elevator will be found best suited for the

purpose; or if a leaden bullet is deeply impacted, the tire-fond screw already alluded to will be found convenient, or Luers' sharp-pointed bullet forceps, which is so formed as to work into the lead and take a firm hold.

In all cases of lodgment, where extraction is attempted, care must be

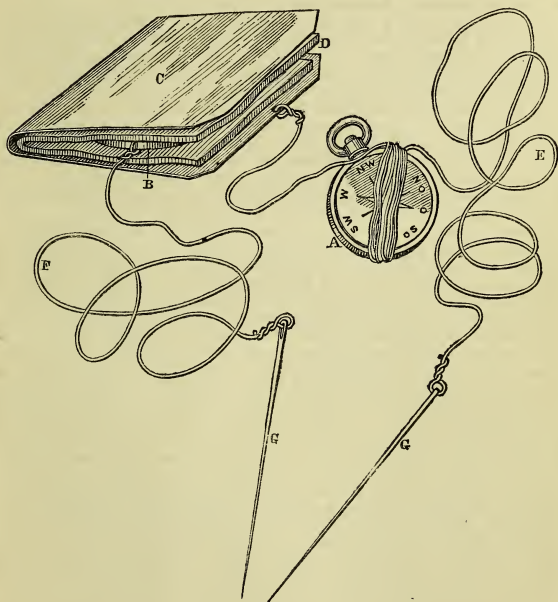


Fig. 45.

A. Pocket compass; B. Copper sheeting (a penny piece will answer); C. Plate of zinc; D. Flannel saturated with dilute acid; E. and F. Insulated wires; G. Exploring needles.

taken not to injure the great vessels and nerves, to cause much irritation to the soft parts by extensive incisions, or to use violence.

*Gun-shot wounds of muscular parts* become painful, swell, and the usual symptoms of inflammation set in from twelve to twenty-four hours. The neighbourhood of a wound in a limb may become discoloured, depending on the amount of contusion and severity of the injury.

The discharge from a gun-shot wound is at first a reddish fluid; after a day or so it becomes darker and thicker; but much will depend on the amount of sloughing likely to take place, as if the parts are much bruised or burnt, which latter condition sometimes occurs from close shots, the character of the discharge will be modified, and separation of the dead from the living will be longer delayed. Following the separation, there will be discharge of purulent matter, which gradually diminishes. As the wound fills with granulation, this discharge may continue for an indefinite period, in consequence of retention in the wound of some foreign body, such as a piece of clothing or a splinter. It is therefore necessary at each dressing to make a most careful inspection of the wound, and remove anything which the introduction of a probe will probably detect.

*Hunter remarks on gun-shot wounds*, "that from the circumstance of commonly having a part killed, in general they do not inflame so readily as those from other accidents; this backwardness to inflame will be in the proportion that the quantity of deadened parts bear to the extent of the wound; from which circumstance the inflammation is later in coming on, more especially when a ball passes through a fleshy part with great velocity, because there will be a great deal deadened in proportion to the size of the wound; therefore inflammation in gun-shot wounds is less than in wounds in general, when the same quantity of mischief has been done; and this also is in an inverse proportion to the quantity of the parts deadened. According to the velocity of the ball, so is the direction. When the velocity is great, the direction of the ball will be in general more in a straight line than when it is small. Velocity in a ball makes parts less capable of healing than when it moves with small velocity; therefore, gun-shot wounds in pretty thick parts are in general later of healing at the orifice where the ball enters, than at the orifice where it passes out; if, therefore, the wound of exit is in a depending position, it may be necessary to keep it open by artificial means."

*Wounds not having a free exit* for discharge, very frequently burrow and give much trouble, more particularly if there be lodgment of an extraneous body. The following case will illustrate such. During the siege of Sevastopol, a brother officer of the writer's, when returning from duty in the trenches, experienced a severe lacerated wound in the anterior part of the left thigh, which he stated was caused by a shell exploding in front of him, causing a ramrod he had in his hand to enter the thigh. At the time the shell exploded there was a soldier standing between him and it. On arrival

in camp his trousers were literally blown off him, and a long lacerated wound extended down anterior of the thigh, but no appearance of an extraneous body. Several days after, the limb became very much swollen, discharge from wound copious and dark coloured, and the back of the thigh presented the appearance of an abscess having formed. On examining wound with a probe, a movable foreign body was discovered, and on making an incision through the thick fascia at the back of the thigh, a long splinter of bone and several pieces of cloth were discovered. The splinter had no doubt caused the wound, and not the ramrod, as was at first supposed, and was part of the thigh bone of the man who was standing between him and the explosion, and who was blown to pieces. On removal of the splinter and pieces of clothing, the wound healed rapidly, the counter opening being the exit of all discharge.

Much surgical interference is often required in following up sinuses, particularly in the neck and lower extremities. Where these burrow between the muscles and fascia, counter openings, and support in the form of compresses and bandaging, will afford the best means of establishing a cure, care being taken when a bandage is applied to a limb that it is commenced at the hand or foot.

*General Treatment of Gun-shot Wounds.*—Gun-shot wounds in their course of treatment will be influenced by many circumstances: derangement of the digestive system, causing fever and dry appearance of the wound; inclemency of the weather; moral influences, such as impatience and irritability of temper, tend to retard recovery. Fortunately, soldiers are most patient: one seldom hears a grumble or a question as to the probable effect of a wound.

*The Treatment of simple gun-shot wounds* should be most simple. The application of a piece of wet lint or linen covered with gutta-percha tissue or oiled silk, retained by plaster or light dressing, will be quite sufficient.

*Ice*, if procurable, may be found agreeable, and will tend to subdue inflammatory symptoms; but if not comforting, or if it produce irritation of the neighbouring skin and induce a pustular eruption, it should be discontinued.

*Painful Gun-shot Wounds.*—When a gun-shot wound is tender, it has been recommended to apply a little oil, lard, or simple ointment; but my experience is that greasy dressings become hard and offensive, requiring frequent renewal, and are consequently objectionable. It is, therefore, better to relieve the sufferer with opiates, or the local application of morphia—say, quarter of a grain sprinkled on the wound.

*The Use of Bandages.*—Mr. Guthrie had a very strong objection to rollers for dressing of wounds. He says they become stiff, bloody, and dirty. He considered they did no good, and were for the most part cut off with scissors and rendered useless. On this point Hamilton, of the U. S. A.,

remarks: "No part of the dressing of a gun-shot wound has more value, when judiciously employed, than a roller. At the same time, nothing is capable of doing more harm. If a roller is carefully applied to the limb at an early period, much of the bleeding is prevented, and most of the

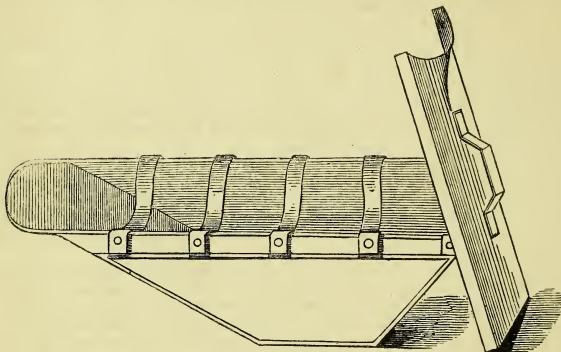


Fig. 46.—Foot bath.

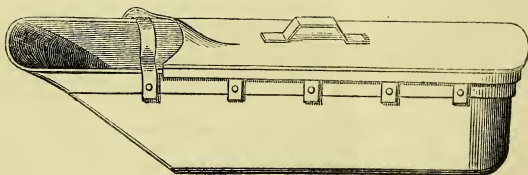


Fig. 47.—Arm bath.

blood which does escape flows out freely from the orifices, which are left open purposely; and thus we are apprised not only of the amount of bleeding, but those extensive intermuscular extravasations are avoided."

*The application of warm water may be followed by relief and benefit,*

applied by means of *spongio-piline* to the trunk, neck, and upper portion of extremities.

Professor Esmarch, in his work on Bandaging,\* describes baths for both extremities, which I saw in use in the German hospital, Versailles, during

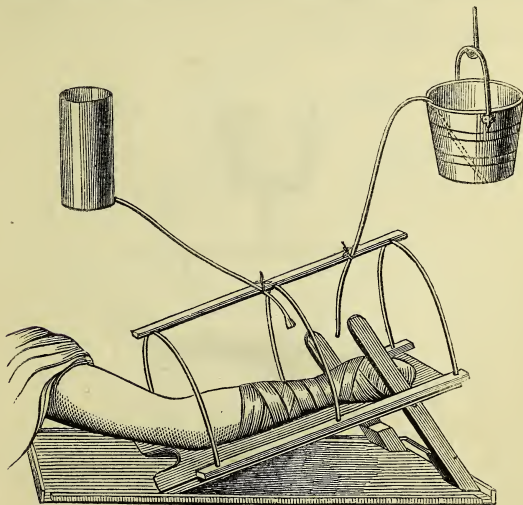


Fig. 48.

the Franco-German War, 1870-71, and which appeared to afford great comfort to the sufferers using them.

The illustration (fig. 46) represents one of these baths for the lower extremity; those for the upper being somewhat longer, as shown by fig. 47.

Esmarch says: "For lengthened immersion it is best to use the arm and

\* 'Verbandplatz und Feldlazareth,' Dr. F. Esmarch, p. 72.



foot bath of plated zinc, numbers of which can easily be prepared for clinical as well as field hospitals.

"The wounded limb should be laid on the suspension straps, which are fastened on either side to metal buttons, so that it will be suspended in the middle of the water." For later steps of suppuration, these baths will be found most useful and comforting, especially in cases of excision, where immersion can be conveniently applied.

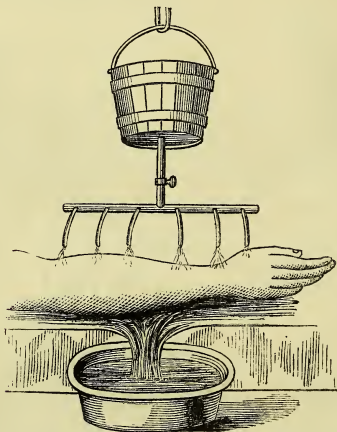


Fig. 49.—Velpeau's Irrigating Apparatus, from Dr. Billroth's 'Surgical Pathology,' p. 72.

*Irrigation* has been advocated by some army surgeons. It is a perfect method of lowering the temperature of a part, and therefore useful in allaying inflammation in injuries of joints.

To carry it out effectually its application must be sufficiently prolonged, as in the event of its being suspended for a short time reaction will set in and the inflammatory symptoms will be more severe.

Esmarch, in his work on Bandaging, &c., gives an illustration (fig. 48) of a very simple plan for using or applying irrigation. By placing a vessel



containing water above the level of the patient, the fluid may be conducted to the affected part by means of a syphon formed of gutta-percha or other tubing, or by means of a piece of cotton-wick or skein of worsted, which will act after the manner of a syphon. A vessel may also be constructed with a pipe near its bottom, to which a tube may be attached.

Velpeau recommends the apparatus for irrigation as shown in fig. 49.

Irrigation is best employed by first laying upon the wound a piece of

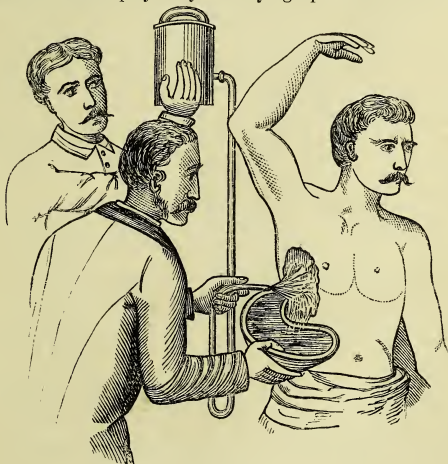


Fig. 50.

lint, cloth, or other soft dressing, much larger than the wound itself, so that it extends several inches beyond its margin. Arrangements should be made on and under the patient's cot for carrying off and collecting the water as it falls off the limb or wounded part.

*Washing Wounds.*—While on the subject of irrigation I beg to recommend a most excellent plan for washing or irrigating wounds, as represented in fig. 50. A gentle or strong stream of water can be applied to

any wound, quite doing away with the use of sponges, which are generally not numerous, and, if present, may be the means of setting up unhealthy action in healthy wounds from having been previously used.\*

With the kidney-shaped tray, as shown in fig. 50, any part of the body may be irrigated without wetting the patient's clothes or bed clothes.

*Poultices*, though useful at times, are most objectionable, and should be avoided as much as possible in military hospitals on active service. When persistently used, they are frequently the means of assisting in establishing cases for amputation which might otherwise have turned out favourably. When no longer required, poultices are with difficulty disposed of, orderlies and sick depositing them in holes and corners (if not most carefully watched) where they are least suspected, and where they become putrid, sour, and encourage flies.

*Disinfectants*.—It is of the greatest importance that every precaution should be taken against the decomposition of sloughs and discharges, and for this purpose the following disinfectants have been recommended, which may be divided into two classes:—

1. Those which prevent or modify decomposition.
2. Those which neutralize products of decomposition.

Under the first class may be included—

Carbolic acid, which in the present day appears to stand foremost in the opinion of some.

Potassium permanganate, chloride of zinc, nitric acid, nitrate of silver.

Under the second class may be included—

Chloride of lime or soda, charcoal, iodine.

*Carbolic acid* should be applied in weak solution, say 2 parts in 100 of distilled water, oil, or glycerine. If applied too strong it produces pain and irritation.

*Potassium permanganate* may be used of a strength according to the nature of wound, one of an offensive character requiring a strong solution. It should be applied with a glass syringe, as contact with sponges, lint, or cloth decomposes it and renders it useless.

*Chloride of zinc* should be used in solution, care being taken not to make it too strong, or it will produce great irritation.

*Nitrate of silver* should be used in solution of from ten to twenty grains to the ounce of distilled water; applied with a syringe.

*Nitric acid* will be found useful in phagedænic ulceration, and may be applied in a pure state or as a lotion.

*Chloride of lime* may be used in solution with water as a lotion, or for disinfecting the air.

*Charcoal* may be used sprinkled on a poultice, applied in powder, to a

\* This plan of irrigation was seen by the writer in the German hospitals, Versailles, during the Franco-German war, 1870-71.

wound or ulcer, or in muslin bags, which latter proceeding is most clean and convenient.

*Iodine* may be used for disinfecting the air or as a lotion.

Other dressings have been recommended besides those already mentioned, such as glycerine on lint or charpie. Carded oakum and carbolized tow are excellent dressings for absorbing discharges and keeping down offensive smells. Tincture of arnica, with water, may be used as a stimulating dressing; or diluted alcohol; tincture of the perchloride of iron, in weak solution.

Above all, in the local treatment of gun-shot wounds, cleanliness must be attended to, as without it no treatment can be successful.

*Constitutional Treatment.*—The constitution frequently requires looking after, the regulation of diet being essential. Cases may occur, such as in wounds of the lungs, where it may be necessary to reduce the patient to a state bordering on starvation; the contrary, however, may be indicated in weakly patients, and after prolonged suppuration or exposure to privation.

*Sanitary Treatment.*—The surgeon should observe strict sanitary precautions about the patient's person, bedding, and clothing, and, when it is possible, ample *cubic space* should be given to each person; for wounded, at least 1200 ft. each in buildings. In huts and tents the allowance may be less.

*Ventilation of buildings* is of the greatest importance; but it must be observed that, though ventilation is necessary, a wounded soldier may have too much of it, and in the treatment of gun-shot wounds *too low a temperature*, or currents of air, may be attended by most serious consequences. During the Crimean campaign and the late Franco-Prussian war, the influence of temperature on suppurating wounds was most remarkable. In the Versailles hospitals many of them took an unhealthy action when the temperature of the wards became very low.

The proposal on the part of Professor Chisholm, of South Carolina, to *pare the edges of gun-shot wounds* in such a way as to prepare them for healing by the first intention, has not been found to succeed by most surgeons.

This plan was originally suggested by Desault and Larrey in wounds of the face. Professor Chisholm was desirous of having the same proceeding for all wounds.

The Director-General, Medical Department U. S. Army, says, "that from the experience and evidence adduced, the results were not satisfactory, and he considers that by attempting to regulate such wounds by the knife, there is great liability of sacrificing more tissue than Nature would have done."

*The Pneumatic System of healing wounds*, as introduced by M. Jules

Guérin, has been mentioned by Deputy-Surgeon-General Gordon, who considers that in its present state, although suitable enough for a stationary hospital, it is utterly unsuited to a movable one. The apparatus having been provided, "the wound should be dressed in the ordinary way, then apply to its surface charpie moistened with tincture of arnica, over that a little oakum, then a bandage moistened with arnica lotion. The air-tight case of india-rubber should now be applied, the tube extending from it being connected with an exhausting glass vessel, from which another communicates with the air-pump. The glass vessel has, moreover, a third opening, by which liquids reaching it from the wound may be discharged without deranging the apparatus in any way; and by means of the ingenious mechanism contrived by the inventor of the apparatus, the action of the air-pump can be reversed, so that the lotion of phenic acid, permanganate of potash, or other remedy, may be applied to the dressings of the wound without taking any of them off. Grave wounds are dressed by M. Guérin once a day, those of a slighter nature once every five or six days. In all cases it is necessary for success that the apparatus be applied to the wound before inflammation sets in, and that during the treatment the patient be well supported by food and extras."\*

*Cotton-wool dressing for wounds* was introduced at the end of 1870 by M. Guérin. This plan of treatment consists in surrounding the wounded limb by very large quantities of cotton-wool, and rendering the whole dressing firm and compact by tightly applied bandages, which are left undisturbed for several weeks.

Wool employed must be of good quality, clean, and free from impurities. If there be a glazed surface, this must be stripped off, and the sheets of wool, torn into long strips about a foot wide, must be rolled up so that they may be methodically applied round the part. The quantity of wool used at a dressing is sometimes enormous; Guérin having employed as much as four pounds. It has to be securely fixed in its place by means of bandages, which establish a considerable amount of elastic compression.†

#### BAYONET, LANCE, SWORD, AND ARROW WOUNDS.

Bayonet and lance wounds come under the head of punctured wounds; sword, as incised; and arrow wounds as a combination of lacerated and punctured. The latter will be only considered here, as the former have been already alluded to.

*Arrow Wounds.*—These are not likely to be met with in warfare between civilized countries, but arrows are still in use among savage tribes, and as the army surgeon might be called upon to exercise his skill

\* Gordon's 'Lessons on Hygiene and Surgery,' p. 130.

† 'Medical Times and Gazette,' 31st Oct. 1874, p. 506.

in the treatment of such wounds, the following information may be found useful.

Mr. Hamilton describes "the point of entrance of an arrow as being indicated by a narrow slit, the margins of which are slightly discoloured, resembling very much the wound made by a small ball. The wound of exit resembles the wound of entrance, except that it is not discoloured, and is somewhat larger.

Suppuration can seldom be avoided.

Profuse hæmorrhage, extensive abscesses, empyema and tetanus, are



Fig. 51.—Wire loop for extracting arrow-heads embedded in the soft parts.

among the most frequent complications of these accidents, when only the external or fleshy portions of the body are implicated."

The great difficulty to be overcome in the treatment is to remove an arrow which has lodged, without leaving its head; and as the missile appears to be more or less constructed with that view, plans have been devised for removing the shaft and head together.

Doctor Bill, of the U.S.A., has invented an ingenious expedient for removing the barbed heads of arrows when buried in the soft parts of large cavities, or when impacted in bone. It consists of a snare, as represented



Fig. 52.—Wire-twister recommended by Dr. Bill, twelve inches long.

in Fig. 51, the arrow shaft being used as a guide to the wire, and the great danger of detaching the head from the shaft being avoided.

When arrow-heads are lodged in bone, and cannot be detached by slight traction, aided by a gentle rocking motion of the shaft, the plan which Dr. Bill advises is to procure a piece of well-annealed iron wire, two-and-a-half feet in length, to pass the ends through the holes in a long suture wire-twister, and secure them to its handle (Fig. 52), leaving a loop at the distal extremity (Fig. 53). The loop passed over the feathered end of the shaft is to be thrust down to the other extremity and made to snare the arrow-head, and the wire being tightened, the foreign body and instrument

are to be withdrawn together. Dr. Bill suggests that two straightened catheters soldered together would answer in place of the wire-twister, and the *écraseur* now supplied with the army field-instrument cases would probably prove a yet more convenient and reliable instrument. But, whenever possible, it will be preferable to cut down upon the arrow-head, and to remove it with forceps ; for the surgeon should not work in the dark.\*

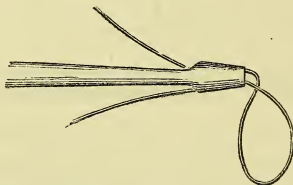


Fig. 53.—Wire loop twisted once on itself for snaring impacted arrow-heads.

“If the arrow has passed nearly through, so that its point can be felt upon the opposite side, the surgeon should cut down upon it by a counter incision, and extract it by that route, as suggested by Larrey ; and in order to facilitate its removal in this direction he may, as soon as the head of the arrow is withdrawn, and the end of the shaft to which it is attached can be seized by the forceps, cut off the opposite end of the shaft close to the skin by a pair of bone nippers ; or if he finds the head and the shaft separated, he may withdraw the shaft on the one side and the head on the other, taking care, however, that the tendinous string (a string which attaches head to shaft) is brought out with the head, otherwise it may be left in the track of the wound. The same practice may sometimes be adopted, namely, making a counter incision to reach the head, even though the head is not felt, provided the surgeon can determine the length of the shaft, and consequently the probable position of the head.”

“An arrow having penetrated bone, an attempt should first be made to extract it by rocking it to and fro in a direction at right angles with the plane of the groove which is made on the outer or feathered end of the shaft.”†

\* ‘Surgeon-General’s Report, U. S. Army, 1865 to 1871,’ p. 162.

† Hamilton’s ‘Military Surgery,’ p. 531.

## INJURIES OF THE HEAD.

THIS important and interesting subject has engaged the attention of numerous writers.

Mr. Guthrie remarks: "Injuries of the head affecting the brain are difficult of diagnosis, doubtful in their character, treacherous in their course, and for the most part fatal in their results."

"The slightest injury to the head may produce effusion, encephalitis and its consequences, plugging of the sinuses by coagula, leading to coma, paralysis, pyæmia and death; while extensive injuries (their aspects at first threatening most serious results), such as fracture, depression, and even permanent compression, from lodgment of bullets or other extraneous substances, have been followed by no such consequences."

*Classification of Injuries of the Head.*—Many classifications of injuries of the head have been suggested, but it appears to the writer that for practical purposes it will be sufficient to consider them—first, with regard to injuries of the containing parts; and second, with regard to the organs contained.

*Contusion of the Head.*—These injuries generally occur in war from spent bullets, fragments of shells, or other missiles, the velocity of which has been nearly expended; or they may occur indirectly from splinters of stone, wood, &c. Whatever their origin may have been, or no matter how slight the contusion, they should be most carefully examined and watched. Mr. Liston has remarked that "wounds of the head of the most trivial character are not to be despised, or of the most severe not to be despaired of." This maxim should always be kept in view.

*The treatment of simple contusion* consists in the application of cold water to the part, and the administration of cathartics; light diet, no stimulants, and most perfect quietness.

*Severe contusions*, accompanied by a tumour, are sometimes difficult to distinguish from depressed fracture, the centre of both giving to the hand a hollow or depressed feeling. To the inexperienced these bloody tumours are a source of great perplexity, but they will in general be distinguished by their having a well-defined margin or wall, and when the hand is passed over from the sound part it will first feel this hard wall or margin, and then suddenly experience a soft depression in the centre of the tumour.

In a fracture with depression there will be no defined margin or soft centre, the depression being gradual and hard to the touch; besides, there will in all probability be symptoms of compression accompanying the injury.

These tumours may give trouble by suppurating, the effused blood acting



as a foreign body ; but as a rule they become absorbed with the use of cold applications. When, however, suppuration takes place, the tumour must be incised, and free exit made for the escape of matter. Severe contusion, accompanied by an open wound, may be followed by erysipelas, abscesses, perioritis, or necrosis, as well as inflammation of the brain and its membranes.

The treatment of these contusions does not differ from similar injuries in any other part of the body ; but with complications of erysipelas, abscesses, &c., the treatment requires to be most active, in consequence of the close proximity of the brain and possibility of inflammation extending.

*Contused Wounds, with Fracture of the Cranium, without Depression.*—These injuries but seldom occur, and, as regards the fracture, are difficult of diagnosis ; a fissure through both tables may exist, without producing any alarming symptoms or external evidence.

*Furrowing of outer Table.*—There may be furrowing of the outer table without injury to the inner, this being caused by the passage of a ball across the skull, striking in such a position that it does not enter—in fact, a graze of the bone—which as a rule is followed by most unpleasant symptoms, such as inflammation of the brain and its membranes, necrosis, and abscess.

In the treatment the surgeon must be guided by the amount of constitutional disturbance and cerebral symptoms, applying local remedies such as are recommended for contusion with open wounds, subduing inflammation, and keeping the patient perfectly tranquil.

*Contused Wounds, with Depression.*—These injuries are as a rule so connected with the consideration of compression, that it is scarcely necessary to touch here on the subject. It may, however, be stated that patients have recovered from such injuries without the depression being elevated ; the surgeon must therefore be guided by the urgency or otherwise of the symptoms, to decide him as to the necessity of cutting down or dividing the scalp to examine the bone, and form an originally simple fracture into a compound.

Sir A. Cooper, Abernethy, and Dupuytren, recommend that, if the depression does not produce symptoms of compression, it is best not to interfere. Mr. William MacCormack remarks on this subject: "One point regarding which opinions vary somewhat, is respecting the treatment of depressed fracture unaccompanied by symptoms, and with an external wound. Where there is no wound, he would be a hardy operator who should cut down upon a depression in the skull, in the absence of any symptoms of compression. When there is a wound, however, the case is different ; but even here I question much if the surgeon ought to do more than simply remove such loose fragments as can readily be got at."\*

\* 'Notes and Recollections of an Ambulance Surgeon,' by William MacCormack, p. 65.

*Penetrating Wounds of the Cranium* generally prove fatal ; but instances have occurred of recovery when the bullet or other missile has been surrounded by lymph, and the brain becomes accustomed to its presence.

When a missile has entered the brain, it is almost impossible to remove it, and an attempt to do so may only cause further injury ; if, however, it can be felt superficially, it should be removed.

*Fracture of the Inner Table of the Cranium.*—The inner table of the skull may be fractured without signs of depression, or fracture of the outer table, or detachment of the pericranium. On this description of injury Guthrie remarks that in the great number of broken heads that he had under his care on many different grand occasions, that he has never actually known the inner table to be separated from the outer, without positive marks of an injury having been inflicted on the bone or pericranium. An operation, he says, should never be performed under the expectation that such an accident may have happened, unless it be apparently required by the urgency of the symptoms, indicating compression or irritation of the brain, which cannot be relieved by other means, and are about to prove fatal.\*

*Fracture of both Tables.*—There may be comminuted fracture of both tables, without producing the slightest symptom of compression, the bone having been broken into such small pieces that they rest loosely on the dura mater, and cause no cerebral symptoms ; the treatment in such a case being cold applications and perfect quietness, with strict observance of diet, and no excess.

*Fracture from Contre-Coup.*—This accident, causing a fissure of the parietal bone, or fracture at the base of the skull, where it is most common, is of rare occurrence in the army. Out of 12,980 injuries of the head during the American War of the Rebellion, there were only two cases recorded of this peculiar injury. The fracture is accounted for by a heavy blow being struck against a hard resisting part of the skull, and the shock transmitted causing the thinnest and most brittle portion, though at some distance, to give way.

This fracture is never depressed, and is very difficult to recognise. In some instances it has been diagnosed by a sensation of crepitus being given to the hand when the head has been gently moved.

The treatment should be entirely constitutional, consisting of mercury, according to gravity of symptoms, and purgatives, the head being placed in a soft pillow.

*Fracture of the Base of the Skull.*—A fall from a height, or a blow on the vertex or side of the head, may produce this description of fracture, which usually extends from the point struck across the base of the skull, and not unfrequently running through the petrous portion of the temporal bone or into the foramen magnum.

\* Guthrie's 'Commentaries,' 1855, pp. 341, 342.

This is a most serious accident, and very commonly attended by fatal results; still there are instances of persons having lived for a considerable period after such injuries.

Writers on this subject have endeavoured to lay down rules or particular signs and symptoms for certain seats of fracture in the base of the skull, but unfortunately such definite information does not help one in the treatment; it may assist the surgeon in forming his diagnosis.

A fissure extending through the *anterior fossa* may be accompanied by extravasation of blood into the orbit or eyelid, or there may be free hæmorrhage from the nose.

Should the *middle fossa* be implicated, there will very likely be fracture through the petrous portion of the temporal bone, with injury to tympanum; there will then be a discharge of blood or serum from the ears.

When the *posterior fossa* has been fissured, there may be some difficulty in distinguishing the exact nature of the accident, unless the fracture passes through the petrous portion, and then there will be the characteristic signs of such an injury.

Mr. Erichsen considers "there are two signs, the occurrence of which, separately or together, leads to strong presumptive evidence in favour of the existence of this kind of fracture. These are, 1st. The escape of blood from the interior of the cranium through the ear, nose, or into the orbit; and 2ndly. The discharge of a serous fluid from the ears, and occasionally from other parts in connection with the base of the skull." He further says: "Bleeding from one or both ears after an injury of the head may arise from any violence by which the tympanum is ruptured, without the skull being necessarily fractured. If, however, the hæmorrhage be considerable, trickling slowly out of the meatus in a continued stream, if the blood in the external ear pulsates, and more especially if the bleeding be associated with other symptoms indicative of serious mischief within the head, and if it have been occasioned by a degree of violence sufficient to fracture the skull, we may look upon its supervention as a strong presumption that a fracture of the base of the skull, extending into the petrous portion of the temporal bone, has taken place.

"Hæmorrhage into the areolar tissue of the orbit and eyelid, possibly with protrusion of the eyeball itself after, accompanies fracture of the orbital plate of the frontal bone. The ecchymosis that occurs in these cases arises from the filtration of the blood from the interior of the skull, through the fracture, into the loose areolar tissue contiguous to the injured bone. It differs remarkably in appearance from that resulting from a direct blow upon the eyelid—from a "black eye." In the latter case there is bruising of the skin, and the ecchymosis is in a great measure cutaneous, of a reddish-purple colour. In the ecchymosis from fracture, the hæmorrhage is

entirely subcutaneous. There is probably no bruising of the eyelid, but this is tense, greatly swollen, and of a purple colour. The extravasation can clearly be seen not to be in the skin, but to shine through it.”\*

The discharge of serum from the nose or ear, which in the latter “wells up” as quickly as it is removed, and may flow to the amount of several ounces, is generally admitted as a certain sign of fracture of the base of skull.

*Scalp Wounds* frequently occur to artillery men, at the rapid practice of mounted artillery, by men being thrown off the gun carriage when going very fast, and a wheel meeting with the man’s head will detach a large portion of the scalp. When such accidents occur, it is only necessary to clean the exposed surfaces and replace the torn scalp, when in all probability the parts will heal without any trouble. Occasionally the surfaces will not unite, even under the most careful management; but certain portions will do so, abscesses very likely forming in other parts. Care should be taken to evacuate the abscesses at an early period by adequate incisions.

If the scalp has been much bruised, it may not adhere until suppuration has taken place; when well-regulated pressure will expedite recovery.

*Sabre Wounds* on the top of the head are not by any means so dangerous as those on the side. Sabre cuts will generally admit of being at once replaced, and in many instances, with the aid of a few stitches and proper supporting bandage, they adhere without further trouble.

With section of scalp, cranium, and even brain, from a sabre, recovery may take place.

*Erysipelas of the Scalp* generally occurs after contusion or punctured wounds, influenced by constitution of patient and sanitary state of the hospital and its neighbourhood. The treatment should be regulated by the powers of the patient and state of constitution. In the milder forms, where there is simply a reddish blush, the part should be punctured with the point of a lancet, followed by warm applications, such as poultices. In the severer form, where there is great puffiness, without redness, the parts should be incised, the incisions being two to three inches long, and warm poultices or fomentations then applied. The bowels should be regulated, and if the constitution be low, wine, ammonia, bark, and good diet, must be administered.

*Pyæmia* is not an unfrequent complication of injuries of the head, and it is after slight injuries to the scalp, and not cerebral, that the disease presents itself, the severer injuries not lasting sufficiently long in consequence of the sufferer not living for the disease to develop itself. The character of the disease does not differ when in connection with these wounds from elsewhere. “The general line of treatment is the same as for pyæmia from

\* ‘Science and Art of Surgery,’ by J. E. Erichsen, vol. i., p. 371.

other causes ; but it has been suggested, with a view to prevent its development, when there has been contusion of the cranium, to remove the diseased bone with the trephine. The operation would be attended by dangers peculiar to itself ; there would be no limit to the parts to be removed, and no certainty as to necrosis attacking the contused bone after the injury, and consequently the operation is not considered justifiable."

Injuries of the head affecting the brain have been divided into injuries from concussion and injuries from compression or irritation of the brain.

*Concussion.*—It is difficult to explain what concussion really is, but it appears to be a shock communicated to the nervous system, in consequence of some external injury or violence producing disturbance of the substance of the brain and interfering with its circulation.

The functions of the brain may be temporarily suspended, insensibility being slight and transitory, or it may be prolonged for several hours, or the patient may sink without recovering consciousness.

*The symptoms and signs of concussion* are influenced by the extent of the injury to the brain. When very slight the feelings may be only faintness, giddiness, or mental confusion ; but when the injury is severe, there will be insensibility, surface of body cold and pale ; the sufferer, when spoken to in a loud tone, may answer in an incoherent manner, falling again into a state of semi-unconsciousness ; muscular power is lost, pulse feeble, bladder and bowels act involuntarily, pupils contracted, breathing appears to have ceased, circulation has been suspended. This condition may last for a few minutes or hours, and is the first stage ; its duration depends on severity of the shock. In the second stage stupefaction continues, though the patient may be cognizant of being moved or roughly handled. It may be possible to rouse him, which partial consciousness is one in favour of there being no compression ; when the pupils are contracted, both being alike, it is also a symptom in favour of there being no compression.

Vomiting may occur, which is generally considered a good sign, as it stimulates the heart's action, and causes the blood to flow through the vessels of the brain. As circulation is being gradually established the pulse becomes fuller, and surface warmer. When the injury has been more severe, the symptoms are more marked ; there is complete prostration, eyes glassy, pupils may be contracted or widely dilated, surface cold ; and, in fact, the patient appears moribund. These symptoms may last for hours, or merge into the severer complications of compression.

In concussion the breathing is rarely stertorous, a symptom which if present and continual, might be considered as of compression.

*Treatment of Concussion.*—Endeavour to revive the energies of the nervous system and circulation by application of warmth to the body by means of hot jars or bottles, blankets, and employment of friction to the surface. Administer warm drinks, but no stimulants, unless reaction cannot

be brought about without them, and then they should be given in very small quantities, their action being carefully observed. The administration of an enema, containing some aromatic spirits of ammonia, has been recommended. Reaction having taken place, the object is to try and prevent inflammatory action. There should be perfect quietness, mentally and bodily, in a darkened room, the latter having a decided influence in preventing congestion. Cold should be applied to the head, mercurial purgatives administered, stimulants avoided, or excess in diet or excitement of any kind. Should symptoms continue, blood may be abstracted from the back of the neck by leeches, or cupping, or general bleeding may be considered necessary. Blister to back of neck, or the insertion of a seton, have afforded relief in protracted cases.

Should inflammatory symptoms become apparent, the treatment must be most active: bleeding from the arm, the most powerful remedy we have, should be regulated by the pulse, and repeated as often as the symptoms recur. The head should be shaved and ice applied; mouth touched by the administration of mercury as quickly as possible, either by inunction or by the mouth. Perfect quietness must still further be enforced.

During the convalescence, when the constitutional powers become depressed, small quantities of stimulants may be given, or, where there is sleeplessness and delirium, opiates give much relief.

*Compression means* pressure on the brain by a portion of bone, bullet, extravasation, blood, or formation of pus, or anything that may press on it or enter its substance, causing characteristic symptoms, some of which are as follows:—insensibility, breathing heavy, laboured, slow, accompanied by stertor; cannot be roused; there is a peculiar noise caused by the breath being emitted from the corner of the mouth, something like a puff or whiff caused by the velum pendulum palati hanging down in the mouth; the pulse is usually slower than natural, but at times irregular and occasionally quick. If the shock has been slight, the countenance is flushed; but if it has been great, it will be found pale and livid. The sufferer may be convulsed and unconscious of anything about him.

The pupils appear to vary according to the part of the brain injured, and are not affected by the degree of injury. At first they are generally contracted, subsequently dilated, or one may be contracted and the other dilated; and as the disease advances, or becomes aggravated, they are immovable. The lips are usually compressed, and if an attempt is made to give fluids they run out at the corners.

There may be paralysis of one side, or of one side of the face; paraplegia or hemiplegia.

At first the secretions are retained; subsequently they pass involuntarily.

If the injuries have existed for a day or so, it may be necessary to



diagnose between compression from extravasation or from depressed bone, or inflammatory effusion within the skull.

In cases of depressed fracture the symptoms are uninterrupted, and on careful examination the existence of an injured bone will in all probability be discovered.

In cases of effusion from pus, lymph, or serum, the result of inflammation, causing pressure on the brain, symptoms of cerebral inflammation will precede the symptoms of compression.

*Treatment of Compression.*—A wounded soldier, suffering from symptoms of compression, appears before the surgeon: the first consideration will be, What is the cause of it? and if that can be ascertained, What shall be done to relieve him? The cause, however, may be obscure, arising from damage within the skull, and probably beyond the reach of the surgeon. The treatment in such a case should be constitutional, and very guarded. Watch for continuance of symptoms, and, if not relieved, an endeavour should be made to bring the sufferer as quickly as possible under the influence of mercury, cold to the head, and perfect quietness, with a view to prevent the approach of inflammation. Bleeding may also be adopted.

In cases arising from causes apparent to the surgeon, such as depression of the inner table of the skull, or depression of both tables, with lodgment of bullet or other missile, the treatment is a matter which will require the most grave consideration.

The wounded soldier should be most carefully examined, with a view to discovering the source of compression, and should the most rigid antiphlogistic treatment not relieve the cerebral symptoms, it will be necessary to consider the advisability or otherwise of using the trephine elevator or saw; but on this point numerous and adverse opinions have been expressed by some of the most eminent civil and military surgeons.

Mr. Hennen considers that all extraneous matters should be removed; that fractured portions of bone, if they lie loose, be extracted; and that depressed portions be elevated when it can be done without the infliction of additional violence, but to keep in view the tendency of the brain and its membranes to inflammation.

Mr. Brodie is in favour of non-interference, and says, Ought we not to regard it as a general rule that the extraction of a bullet should not be attempted? an exception to the rule being only made in those cases in which, from its mere superficial situation, and other circumstances, the extraction can easily be accomplished without employment of force.

Mr. Guthrie remarks with reference to the question—What is to be done where there is breaking down and splintering of the inner table with depression? there can be no hesitation in answering that in all such cases the trephine should be applied, although no symptoms should exist, with a view of anticipating them. He considers that the danger resulting from the



application of the trephine in such cases bears no proportion to the risk incurred by leaving the broken portion of the bone as a constant cause of irritation.

Professor Longmore says, when irregular edges, points of pieces of bone, or foreign substances forced down, and evidently penetrate, not merely press upon the cerebral substance, or where abscesses manifestly exist in any known site, and relief cannot be afforded by simpler means, at the wound itself, trephining is a proper operation to be resorted to for effecting the necessary relief; but in all other cases harm will probably be avoided by abstaining from trephining, while benefit will be effected by simply resorting to long-continued constitutional treatment.

Dr. Stromeyer, of the German army, abandoned the practice of trephining in 1849, though in the early part of his professional career he advocated it in complicated fracture of the skull, and after the Franco-German War—1870-71—he expressed himself as follows:—"I have tried to exclude entirely from military practice the use of the trephine as useless in some, and unnecessary in other cases." He considers a state of coma from depressed skull no more as an indication for applying the trephine than a comatose state in typhus, as an indication to rouse the patient from it by other means; but those which are in accordance with his general state, cold for instance, but not stimulants. As soon as the fragments of the skull become detached by suppurating, the comatose state ceases by itself.

"The great difficulty in settling this skull question consists, then, in that some patients survive the use of the trephine, or of an early extraction of splinters, and that some recover their senses very soon after the operation. This seems to be a conclusive proof of the legitimacy of active interference. But there is no depending upon it: the patient may die just as well after having recovered his senses completely, and, as experience has shown, more easily, than if you let him continue comatose by not disturbing the splinters. This might have been expected from very solid physiological reasons. By taking away the splinters at an early period in cases where the dura-mater is wounded, you open the arachnoid cavity; air and acrid matters can enter it. Brain substance when bruised thus becomes putrid, while it might have been eliminated by absorption without access of air. Subcutaneous operations practised in modern times have done a great deal to put more stress on excluding air; but Brodie and Dease were of opinion that access of air was to be avoided in cases of fractured skulls, and that no interference ought to take place for depression unless it was warranted by cerebral symptoms."

Surgeon J. G. F. Holston, of the U.S. Volunteers, gives his experience of operative interference in wounds of the head, in the following words:—"I will briefly state my views of trephining under the three heads of primary, intermediary, and subsequent operations.

"Primary operations are indicated—1st, when the scalp is wounded and subjacent bone broken, so as to press upon a portion of the brain that cannot be relieved in any other way; for in this case the brain has already suffered, and will suffer still further injury, if not relieved. Commonly some portion may be picked away by forceps, so as to render the operation of trephining unnecessary, as by means of the lever the depressed bone may be elevated. In these cases it has been my practice to remove all depressed bone, a little more or less making no difference. I have preferred the chisel for such removal, as the sharp edge of the chisel will cut



Fig. 54.—Holston's Chisel.

cleaner and with less irritation than the saw, the teeth of which tear the tissues, and give almost as much shock for every tooth as the chisel and mallet do at every blow.

"2nd. Where a missile, clothing, &c., had entered the brain, and by cautious sounding detected near the orifice. Where they are not so found, I should make no curious exploration of the interior of the cranium, believing that the patient may be more severely hurt by exploration than by the original injury. I should content myself in such cases by removing all extraneous spicula of bone and other detrimental matter that may be in the orifice of the wound.

"3rd. Where there is no external wound, but indirectly a large compression of bone on the brain. If symptoms of compression are gradually deepening, there can be no doubt but we should relieve the brain of pressure; in this case probably blood has been poured out from one of the meningeal arteries.

"I consider such operations intermediary as are performed on the patient before he has recovered from the immediate injury inflicted. These operations are by no means as successful as the first, and are generally done in such cases as have not had proper treatment or attention. But there is one condition, which happens occasionally, when a certain part of the skull has been struck without external wound, or without any sign of compression coming on immediately. After several days, coma begins to manifest itself; and here we have probably to deal with supuration, which, if not speedily provided with an outlet, will sink deeply.

"Subsequent operations are such as are performed for the removal of some difficulty left behind, such as epilepsy, paralysis, &c. As regards success,

I would reckon first the subsequent, next the primary, and lastly the intermediary operations, which are least successful of all. These are the rules which guide us in private practice, but I found in my experience in the army that they did not hold good. The injuries of the head are there so much more violent, that I am inclined to think non-intervention to be the safer practice. I believe I have seen more injuries of the head recover without trephining than with, so that it is an open question with me, whether trephining should not be either entirely abandoned, or left to the judgment of one specially qualified in the matter."

M. L. Legouest advocates the following principles and measures. He says the indications for the use of the trephine are immediate and remote. "I give three reasons which are generally admitted, rather than others which might be disputed. The immediate indications can be arranged under three heads:—

"1st. A foreign body having entered the pericranium and penetrated the interior of the cavity of the skull.

"2nd. The discovery of depression of the bone.

"3rd. The immediate appearance of symptoms of compression, such as drowsiness, coma, paralysis, hemiplegia, with or without apparent fracture or lesion of the integuments.

"The remote signs for practising the use of the trephine are perhaps less certain than the immediate ones."

He considers the trephine ought to be used, as it has often removed objectionable symptoms, and because surgical incisions of the meninges of brain can be cured, as numerous instances may be cited of accidental lesions of these structures having terminated satisfactorily.

The dangers consequent on the operation of trephining are not more serious than those of compression carried on for any length of time, and the chances of encephalitis are equal in both cases. Again, he says there is no operation that has caused so much discussion as trephining, and it is perhaps worthy of remark that the greater number of reasons alleged against it are more theoretical than practical.

The opinion I have formed on this most important subject, after some experience in military practice, is that when symptoms of compression exist from depression of the inner table or both tables, with splintering or extravasation, it is necessary to remove the cause, if possible, by some surgical means, and that of the instruments in use the trephine is the most objectionable, requiring considerable force, and consequently liable to cause additional injury to the sensitive brain and its membranes. I therefore consider the use of the elevator, Hey's saw, the chisel and mallet, better suited for the operation than the trephine.

When surgical interference is necessary, too much care in the manipulation of instruments cannot be observed during the operation.

There is no operation that requires greater nicety or delicacy than the removal or elevation of depressed bone or extraneous bodies from the surface or substance of the brain; but to secure success from the expedient much is required in the after-treatment, such as perfect quietness, antiphlogistic regimen, cold to the head, and avoidance of any excitement. During the Indian Mutiny, 1857, a striking instance of this came under my observation. At the battle of Sultanpore a soldier of the 10th Foot was wounded in the head, causing a depressed fracture which rendered him insensible. The surgeon of the regiment elevated the depressed bones, and sensibility immediately returned. The sufferer was progressing satisfactorily when the necessity for shifting camp produced great disturbance, and brought on a train of unfortunate cerebral symptoms, from which he died.

Some authorities have raised a question as to the best period for using the trephine, that is, on the first or seventh day. Mr. Guthrie expresses himself in the following terms: "I do not hesitate to say the first, believing the violence to be greater when done on parts already in a state of inflammation than when they are sound." Another eminent authority remarks on this point: "Danger does not arise from early operation, but from delay." There is no doubt that if it is necessary or advisable to use the trephine or elevate the bones, the sooner the operation is performed the better, so that the cause of irritation may be at once removed.

*There are certain parts of the skull to which it is recommended not to apply the trephine:* for instance, over the venous sinuses; the anterior angle of the parietal bone; the course of the sagittal suture; and near the base of the skull.

Sir W. Fergusson says: "The trepan may be applied in any part of the side or upper portion of the cranium, and a knowledge of anatomy will indicate where the bones are thick, or the reverse, and also where the meningeal artery or the sinuses are in danger. The latter, I should imagine, may always be avoided; the former, if it is necessary to operate over its course, may possibly be cut across, as at the side of the cranium it often runs in a canal of bone instead of being merely in a groove; a small pin of wood in such a case would suppress the bleeding, and any escape that might happen ere this could be introduced would probably be rather an advantage than otherwise; for, generally those who require this operation have been in robust health previously.

"The irregular thickness of the bones at different parts should be remembered, and the pressure of the teeth should be made light or heavy in proportion. At the frontal sinuses Sir Charles Bell recommended that the inner table shall be taken out with a smaller-headed trephine than that which has been first applied; the larger external opening permitting the entire circumference of the cutting margin of the latter instrument being

placed directly on the surface within; such an operation must, however, be rarely required in this situation.”\*

*The secondary consequences of injury of the brain* are—inflammation or traumatic encephalitis, deposit of pus within the organ or upon its surface or membrane.

Inflammation of the brain may occur at any period after receipt of injury. It may set in immediately, or not for many days or even weeks.

The symptoms of inflammation of the brain and its membranes being so much alike, that where one is affected the other is certain to be so, it would be impossible to draw any line of distinction.

*Suppuration within the cranium* has been divided into subcranial, intrameningeal, and cerebral. By subcranial is understood a deposit of pus between the skull and dura-mater. It occurs opposite the seat of injury or part struck. It may be induced by a blow on the head, causing separation of the dura-mater from the bone by disturbing vascular connection and setting up inflammation of pericranium and necrosis, or by irritation caused by splinters of inner table, as in depressed fracture.

The intrameningeal suppuration is an accumulation of pus in the cavity of arachnoid, or in the pia-mater. The intracerebral form is an abscess in the substance of the brain itself, caused by direct injury, by splinters of bone, bullets, or other missiles, or by contra-coup.

*Treatment of Inflammation of the Brain and its Membranes.*—The treatment should consist of most vigorous and antiphlogistic measures—local or general bleeding, mercury, and cold to the head; these measures having been fully tried, without any abatement of the symptoms, the question of trephining arises in anticipation of pus having formed, but the surgeon has to solve two difficulties before attempting such an operation.

1st. Is he certain suppuration has taken place?

2nd. Where has it formed, that the trephine may be applied to allow of its escape?

*Trephining in case of Suppuration.*—Suppuration may be suspected when the inflammatory symptoms are interrupted by a rigor, or accompanied by hemiplegic paralysis on the side opposite the seat of injury. The formation of a puffy swelling on the scalp over the seat of injury has been suggested as the proper position to apply the trephine, but there would be no certainty in finding pus; the trial has, however, been attended by success.

*Hæmorrhage* has occurred to such an extent in injuries within the cranium, that it has been necessary to ligature large arteries. Fortunately this is a rare occurrence.

*Protrusion of the Brain or Fungus, or Hernia Cerebri.*—This arises in

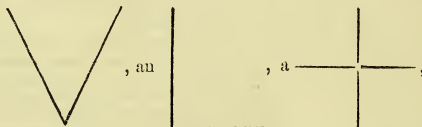
\* ‘A System of Practical Surgery,’ by Sir William Fergusson, p. 4.

consequence of the dura mater having been torn, or by ulceration taking place after removal of a portion of the skull.

If the dura mater remains whole, and the wound in the cranium is small, the hernia will not take place, or if a large portion of the cranium has been removed, there will be no protrusion. Mr. Guthrie is of opinion that it is more likely to take place with a small opening than a large one. At first the protrusion may only consist of coagulated blood, appearing within one or two days after the injury, and is generally a fatal symptom. It may occur at a later period, when it will consist of brain substance and attain the size of a small orange. It is a very dangerous complication; terminates usually in encephalitis, followed by delirium and coma, consequent on inflammatory effusion within the skull.

*Treatment.*—It has been recommended to shave off the fungus, apply a wet compress of lint, and a bandage. In a few instances this course has been followed by granulation of the surface and cicatrization of the wound; but as a rule the fungus grows again, and the patient is destroyed by irritation and coma.

*Application of Trephine as recommended by Sir W. Fergusson.*—"The scalp must be sufficiently opened by a



or any other incision that may be most convenient; next a perforator should be applied to make a hole in the external table, into which the central pin of the trephine should be placed, and then by rotatory motion the teeth should be carried into the bone. The external table and the diploe may be cut with bold and free movements, but caution is required when the inner plate is encountered, as also in those parts where there is no diploe, and where the thickness is irregular and uncertain: the centre pin should now be drawn above the level of the serrated edge of the saw, and again, by more cautious movements, the vitreous table must be divided. When the incision is supposed to be nearly completed the instrument must be removed: an elevator should then be introduced, so as to raise the loosened portion, and the rest of the operation may be conducted according to circumstances. When a foreign substance, blood or matter, is sought for under the cranium, a circular piece of bone is thus removed; but in the case of depressed fracture, only a little more than a semicircular portion requires



to be cut ; and this, be it observed by the young student, is taken from the sound portion of the bone, not that which is depressed ; for the sole object in applying the instrument in a case of this kind is to permit the introduction of a lever to elevate the portion in fault.

“In using the trephine commonly sold, it is necessary to raise them from the groove from time to time, so as to allow the particles of bone to be brushed away ; but the blade being slit up obviates this. However, towards the latter part of the operation it is proper to remove the teeth once or twice and examine the fissure with point of a probe, a slip of quill, or any other convenient article, so as to make sure that the dura mater is not in danger from the skull-cap being thicker on one side of the opening than the other.”\*

\* ‘Practical Surgery,’ by Sir W. Fergusson, p. 463.



## WOUNDS OF THE FACE AND ADJACENT PARTS.

WOUNDS of the face, like those in other parts of the body, consist of incised, contused, punctured, and lacerated.

The ratio of mortality from these wounds is not great, but they are liable to be attended by serious disfiguration and troublesome complications in lesions of the ears, nose, eyes, cheeks, forehead, tongue, jaws, teeth, and mouth, interfering with articulation, mastication, deglutition, hearing, seeing, smelling, glands, and ducts. The causes of mortality in these wounds or injuries may be classed under the heads of secondary hæmorrhage, lodgment of bullets or other missiles in bone, severe strain on the constitution from suppuration, and swallowing foetid pus and decomposed tissues, inability to take food or masticate, neuralgia, and paralysis; the sufferers, in some instances, when the bone becomes permanently diseased, being most wretched and miserable, from the continued foetid discharge preventing them from joining the society of their fellow-creatures.

All wounds of the face show great aptitude for healing. It is, therefore, best to endeavour, with the least possible delay, to cleanse and approximate the parts, bringing them together with fine sutures, while, when a wound has been inflicted by sharp instruments, and is not deep, the skin only should be included by the silk; but in the event of the cheek being divided into the mouth, the stitches should be somewhat deeper.

In the event of bones being cut into, separated, or displaced, they should be re-adjusted, and, having been cleansed, the skin should be brought over them and stitched, as in the case of an incised wound.

Professor Chisholm gives an account of the plan adopted by medical officers of the Confederate Army in the treatment of wounds of the upper jaw. There was fair result, but much deformity was left in many cases. "Unless the fragments are either completely detached or but slightly adherent, they should not be taken away, but should be replaced with care, as in time consolidation may take place, and very little deformity will be left. Should some of these fragments die, they will be found loose, often as early as the sixth or eighth day, and should be removed. Cold water dressings, with an occasional dose of salts to relieve the excessive swelling, is the only medication required. The wound in the face, after careful adjustment of movable fragments, should be closed with adhesive plaster, and, with the use of cold water dressings for a few days, the case is left pretty much to Nature."

My experience of wounds of the face during the Crimean War quite concurs with the foregoing, in adjusting and supporting the parts, and no interference with fragments of bone or teeth unless completely detached.

*Wounds of the lower jaw* are allowed to be more troublesome than wounds of the upper jaw, and are certainly more numerous. It has been remarked by Dupuytren that they are more dangerous than the upper, but such has not been the case in late campaigns. The great obstacles to be overcome in the treatment of gun-shot wounds and extensive injuries of the lower jaw, are—1st. The difficulty of keeping the bone in proper position, in consequence of its liability to hang down. 2nd. The incessant discharge of saliva. 3rd. The difficulty of feeding the sufferer.

After a short time, suppuration sets in, and the fœtid smell (which must be relieved by antiseptics) is intolerable to the patient and his attendants.

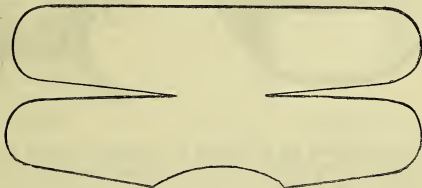


Fig. 55.

Many ingenious contrivances have been invented for keeping the jaw in position, some of which are complicated and expensive.

On service a piece of gutta-percha, about one-eighth of an inch thick, and cut as represented in fig. 55, softened in boiling water, moulded to the jaw as shown in fig. 56, and secured by means of a four-tailed bandage or two handkerchiefs, as shown in fig. 57, makes a comfortable appliance. It may be lined with soft lint or cotton wool, and should be applied with great care.

If an opportunity offers of securing two fragments of bone by fastening together contiguous teeth, it should be done by means of silver wire or silk.

The adjustment frequently checks hæmorrhage, and prevents further mischief from sharp-pointed spiculæ of bone, which from the hard nature of the lower jaw always exists in gun-shot wounds. The surgeon may not be in possession of gutta-percha, when he may substitute pasteboard, leather, or in fact any substance that can be moulded and give support to the jaw.

*Fracture or fissure of the symphysis* is not difficult of detection. Sir W. Fergusson adopts the following method for keeping the fragments moderately steady :—"I shape two narrow wedges of cork about an inch and a half long, and a quarter thick at the base, and sloping away to a point, one of which has been placed on each side between the teeth; and then I have affixed a wetted and softened piece of pasteboard on the chin, which has

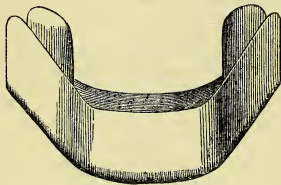


Fig. 56.



Fig. 57.

next been drawn tightly up, by means of a bandage carried from this part over the crown of the head; as the pasteboard has got dry, a kind of mould has thus been formed on the chin, which has obstructed all future movements so long as it has been kept on. The cork wedges have insured regularity as regard the teeth, and an opening has been left between the incisors, whereby the patient has been fed upon soups and other fluid nourishment. Generally, however, the wedges have become loose, and in the course of ten or fifteen days the patients have become accustomed to restrain the movements of the parts, and without taking particular pains about tightening the bandages afterwards, excellent cures have followed."\*

*The profuse salivation* may be relieved by the administration of morphia and saline drinks. The sufferer should be supported by fluid nourishment administered by a tube passed to the back of the mouth, or by a long narrow spoon; indeed, it may sometimes be necessary to support Nature by enemata of beef tea, wine, &c.

Hamilton recommends when the fœtor is excessive, occasioned by the saliva and pus in the mouth, to use a weak solution of the tincture of myrrh in water. With this the mouth should be rinsed often.†

\* Fergusson's 'Practical Surgery,' p. 457.

† Hamilton's 'Military Surgery,' p. 391.

Erichsen remarks: "In fractures of the body of the lower jaw by gunshot injury, there is great comminution and splintering of the bone, followed by copious and fœtid discharge, which being swallowed, may reduce the patient to a state of extreme debility, which may prove fatal. In these cases Dupuytren recommends cutting through the lower lip, the splinters taken away, and, if necessary, resection of the bone." At the assault on the Great Redan, 1855, a brother officer of mine received a bullet wound at the ala of the right nostril. The bullet entered the mouth, smashed most of his teeth in the upper and lower jaw, broke in the hard palate, lacerated the tongue extensively, and broke the lower jaw in several places. His condition was that of extreme wretchedness; but by adjustment of the parts as far as possible, removal of splinters, and support by means of the gutta-percha splint, he was made comparatively comfortable. The suppuration was profuse, and the wounds remained open for a considerable period, but he so far recovered as to be able to perform the duties of a field officer, having had a false palate and several teeth adapted to his mouth.

This officer was supported for several days by fluid nourishments administered through a quill passed well back in the mouth.

No matter how small a shred may be attaching a fragment of skin to the face, an attempt should be made to re-adjust it.

*Wounds of the Ear.*—The external ear may be shot away, or cut off with a sword, or otherwise injured. Instances have been recorded by Paré and Hildanus, of the ear having been completely detached, and when replaced healing without any difficulty. Measures should therefore be adopted, on an ear being cut or injured, to replace any pieces, and secure them by means of very fine sutures, taking care to include the outer skin only, and not the cartilage.

*Wounds of the orbit,* including the eyelids, which may be so injured as to cause much loss of tissue, and the after-consequences eversion and inversion.

The eyeball may be so injured as to cause evacuation of the humours, extravasation of blood into the eye (*hæmophthalmia*), protrusion of the iris, lodgment of extraneous substances, causing impairment of vision from amaurosis, cataract, &c.

*The bones of the orbit may be injured,* and result in inflammation of the brain or its membranes.

Mr. Hennen records a case in which a bullet was lodged in the orbit without causing injury to the eye or the bones; it was removed on the following day by a dressing forceps, was found flattened, and had caused but little irritation to the eye. Such escapes are not often met with.

Bayonets and sharp-pointed weapons perforating the thin orbital plates generally inflict such injury that they are followed by fatal results.

*Incised or lacerated wounds of the eyelid and brow* should be carefully

cleaned, and edges brought together as far as practicable by means of fine sutures, and as quickly after the accident as possible.

Mr. Guthrie suggests a leaden thread as being the best, the first suture being introduced at the very edge of the lid; and two, or as many more afterwards as may be necessary. They may remain for three or more days, as circumstances seem to require.\*

Wounds of the eyeball may be divided into penetrating and non-penetrating.

The treatment of injuries to the eyeball must be of an antiphlogistic character. When severe, it may be necessary to take blood from the temple or arm, and if the organ is not totally disorganised, the iris should be dilated by the application of sulphate of atropine in solution, and calomel and opium given internally, with a view to subduing inflammation.

*Penetrating wounds of the eye* must also be treated by antiphlogistic measures, calomel and opium being given, and the sufferer kept in darkness.

Should the iris protrude, an attempt must be made to put it back; but if that cannot be done, it may be snipped off with a pair of fine scissors. In making the attempt to return the tissue, the solution of atropine will greatly assist the operation.

With regard to the lodgment of foreign bodies in the eye, the Surgeon-General of the United States Army has expressed an opinion, based on reports of gun-shot wounds of the eye during the War of the Rebellion, 1861-65, that: "Whenever foreign bodies are lodged in the eye, they should be extracted at all hazards. If it is impracticable to find them, the globe should be extirpated in order to preserve the other eye."

When *general ophthalmitis* has followed a gun-shot injury, a free horizontal incision, evacuating the contents of the eye-ball, should not be long delayed. Also absolute rest and strict diet.

In *fractures of the bones of the orbital region*, it is not judicious to remove fragments, unless they are completely detached, serving as foreign bodies.

*Injuries of the Nose.*—In cases of incised wounds, the parts must be adjusted, and sutures applied in the same manner as for wounds of the ear, taking care that the skin does not curl in, which would prevent adhesion. Should the nose be broken, it is best to try and place it in its normal position; inserting in the nostrils pieces of gum elastic catheters, or plug with lint or sponge, to preserve the feature, or configuration of the organ, and prevent contraction of the nasal passages and depression of the nose. These injuries are frequently complicated with violent epistaxis, which may require plugging of the posterior nares.

*Wounds of the Cheeks and Forehead.*—These wounds are usually the result of sword or gun-shot, and, when the parts are not completely carried away, will heal most readily if properly adjusted and secured. They have,

\* Guthrie's 'Commentaries,' p. 522.

like wounds of the scalp, the same tendency to attacks of erysipelatous inflammation; it is therefore necessary, during the treatment, to prevent the wound being exposed and to observe strict dieting and temperance.

*Wounds of the cheek* may be complicated with injuries of the *parotid duct*, and to prevent a salivary fistula being formed, Mr. Guthrie recommends: "If the duct of the parotid gland be implicated by an incised wound, care should be taken to divide the cheek into the mouth, if it should not have been already done; and to keep the incised wound open until the external one is closed. If a salivary fistula have formed externally, from inattention or otherwise, it must be treated according to the ordinary methods adopted in such cases. When a wound of the gland itself becomes fistulous and weeps, which is a rare occurrence, it will be best treated by actual or potential cauterization, if moderate pressure should fail."\*

*Injury of the lachrymal bones, or sack*, causing the tears to run over, which misfortune may continue for life, should be treated by endeavouring to remove obstructions in the duct, and prevent the distress which must follow from want of early care and attention.

*Wounds of the tongue* frequently give rise to extensive hæmorrhage, which, if secondary, or occurring several days after receipt of injury, when the process of suppuration is going on, and the tongue is swollen and painful, is difficult to check.

If the bleeding vessels can be discovered, they should be tied, and to do this the tongue must be drawn well forward, or an attempt may be made to restrain the hæmorrhage with styptics, or it may be necessary to tie the lingual artery.

*Wounds of the mouth* are generally in connection with wounds of the face; but they may be still further complicated with injuries to the pharynx, tongue, spinal cord, jaws, and skull.

\* Guthrie's 'Commentaries,' p. 524.



## WOUNDS OF THE NECK.

THE following remarks on the above subject, by Mr. Hennen, are so much to the point, that they may be quoted here with advantage: "It is only from a consideration of the parts of the neck, as they form one complete and sympathizing whole, that we can derive any rational views of the symptoms that may occur from its injuries; or any satisfactory explanation of them after they have taken place. The close and intimate connection of the great vessels and nerves, and of the canals leading to the thorax and abdomen, are such, that separate views of their affections, however they may carry the appearance of minute accuracy along with them, are more the objects of speculative calculation in the closet, than the result of actual experience, and can seldom be of any practical utility in the field hospital."\*

American surgeons subdivide wounds of the neck into wounds of anterior, lateral, and posterior cervical regions; the anterior being grouped into two lesser divisions, as they are inflicted above and below the hyoid bone. Among them, wounds of the larynx, hyoid bone, trachea, pharynx, and œsophagus. In the lateral regions, lesions of the great vessels of the pneumogastric and sympathetic nerves, and of the chain of lymphatic glands. In the posterior region, occupied by muscles, nerves, vessels, but of minor importance compared to the other subdivisions.

*Superficial wounds of the neck* require the same treatment as elsewhere, the surgeon always bearing in mind the great liability to erysipelas in these parts, rapid diffuse inflammation and infiltration.

*Deep wounds of the neck*, such as those produced by stabs, may be accompanied by most distressing symptoms, such as oppressed breathing, nausea, spasmodic twitching of face, paralysis of one or both arms, cough, restlessness, and hiccough.

In gun-shot wounds of the neck it is scarcely possible to have lesion of one important structure without others being implicated; at the same time it has been generally observed that bullets and other missiles pass in and out between muscles, vessels, and nerves, and even the trachea, without causing much injury to any. This is accounted for by the soft and flexible condition of the structure of the neck offering no resistance.

Wounds of the larger arteries and veins generally prove fatal immedi-

\* Hennen's 'Military Surgery,' p. 377.]



ately, but in wounds of the smaller vessels there is frequently much difficulty in discovering from whence does the hæmorrhage arise, and what trunk should be tied. Mr. Guthrie quotes, with great satisfaction, the opinion of M. Velpeau on this subject: "In hæmorrhage from the neck, the mouth, the throat, the ear, or the skull, everything should be done to reach the branch of the carotid which has been wounded, rather than tie the carotid itself."

*In wounds of the larynx*, the parts must be adjusted and kept in contact by bandages, sutures being considered objectionable.

Should a bullet or other missile get into the larynx, it must be removed by operation, and when extensive inflammation is set up, causing infiltration or œdema, it may be necessary to open the trachea, and insert a tube with a view to allowing the sufferer to breathe.

An interesting case is given by the Surgeon-General of the American Army, where the larynx became so obstructed after a wound, that it was necessary to open it and prolong the incision as far as the third ring of the trachea; the proceeding was successful.

Should clots of blood get into the larynx or trachea, and they are not coughed up, an endeavour must be made to remove them by sucking, or by means of an exhausting pump.

Wounds in connection with larynx or trachea, or in their vicinity, should not be closed till all hæmorrhage has ceased, for fear of suffocating the patient. These wounds may be accompanied by emphysema, causing much distress, which should be treated by small punctures, if it extends; but as a rule it will pass away when suppuration of the wound commences.

*For wounds of the œsophagus*, but little can be done, Nature performing all that is required in healing; and it is sometimes most remarkable how quickly this is effected. Wounds of the œsophagus render the patient unable to swallow, without much discomfort, and in many cases not at all, when it will be necessary to give him nourishment by a gum elastic tube introduced through the nose into the stomach or by enemas of beef tea.

During the Crimean War a complicated case of bullet-wound of the larynx and œsophagus came under my immediate care, the particulars of which may be recorded here: At the assault on the Great Redan, the sufferer having mounted the parapet, and while in the act of reloading on his knees, was shot from below by one of the enemy, who was immediately at the bottom of the parapet. He fell on his side, did not feel much pain, but could not speak. On arrival at the camp hospital, there were two wounds in the neck, the ball entered at pomum Adami and made its exit at the anterior edge of the sterno mastoid muscle of the right side. There was very little hæmorrhage from either wound, and no displacement of the thyroid cartilage. The patient was suffering from a frequent cough, with bloody expectoration, loss of voice, and nausea; bubbles of air appeared at

every expiration at the wound in the larynx, that of entrance ; and when he attempted to drink, some of the fluid came through the wound at the anterior edge of the sterno-mastoid, the wound of exit. This latter symptom continued for five days, and then ceased altogether ; for twelve days the air continued to pass through the upper wound and ceased. The cough during that time was very troublesome ; the expectoration being very copious, which caused much loss of rest ; during the first six days there was slight emphysema about the upper wound, but it gradually disappeared.

The treatment consisted at first of antiphlogistic remedies, both local and constitutional ; lint wet with cold water was kept constantly to the wound. He was fed by means of a spoon passed very far back, containing arrowroot, milk, or tea ; his diet was gradually increased after five days, and he was able to swallow bread softened in tea, rice, and milk, and as inflammatory symptoms subsided, wine, porter, and nutritious diet were allowed. The wounds healed completely ; but the voice was much impaired, being little more than a whisper.

## WOUNDS OF THE CHEST.

*Classification.*—Wounds of the chest are divided into penetrating and non-penetrating.

The non-penetrating may be subdivided into wounds of skin, fascia, and other soft coverings of the walls of thorax, fracture of the clavicle, scapula, sternum, vertebræ, ribs, injury of bones or cartilages, and superficial vessels.

The penetrating may be subdivided into those connected with wounds of pleura, lungs, heart, great vessels, nerves, œsophagus, and thoracic duct.

*Non-penetrating wounds* may be accompanied by lesions of the internal viscera, from violence, causing contusion or rupture of viscera or an important bloodvessel, and subsequently by inflammation of the pleura or lungs, giving rise to pleuritis or pneumonia, or both.

Non-penetrating wounds of the soft parts alone differ but little from wounds elsewhere, except that they are much slower in healing, due in all probability to the ribs never being at rest, and consequently the lips of incised wounds, for instance, are not kept in apposition.

In dressing these wounds, it is recommended to apply strips of adhesive plaster in such a manner that the ribs may be supported and wounds relieved from strain; this is best accomplished by placing broad strips of plaster at right angles to the ribs, and bandage round the chest with narrow strips of bandage over the shoulders, stitched to that on the chest, with a view to keeping it in position.

Simple fractures of the several bones in connection with the chest, such as clavicle, scapula, ribs, and sternum, must be treated in accordance with the special principle laid down for these injuries.

In compound fractures of these bones from gun-shot, where the wound does not penetrate, much trouble and anxiety may arise from depressed spiculæ causing inflammatory symptoms and requiring elevation or removal, or giving rise to abscesses or diseased bone.

*Wounds of the external arteries of the chest*, producing profuse hæmorrhage, should be secured at both ends, as from the nature of the surrounding tissues blood is apt to be extravasated or aneurisms formed.

All external wounds, at first apparently trivial, should be most carefully watched for several days, as inflammatory symptoms of the lungs or pleura may arise, and should be checked with the least possible delay.

*Penetrating wounds* may be complicated, in the first instance, with emphy-

sema, pneumo-thorax, hernia of the lung, hæmo-thorax, and presence of foreign bodies, and subsequently by hydro-thorax, empyema, fistulous openings, and contractions of the chest.

In wounds of the heart and larger vessels, the result is generally immediately fatal; at the same time instances have occurred where a sufferer with a wound of the heart has lived for several days.

*Symptoms of Wound of Lungs.*—A penetrating wound of the chest may be accompanied by the following symptoms, which, taken as a whole or in connection with one another, may satisfy the surgeon that the lung has been wounded; but are not proof positive that such is the case, as all may be present, and yet no wound of the lung:—Shock, sudden collapse, or fainting from hæmorrhage, internally or externally; the escape of blood and air through external wound, of pale red colour and frothy; continued issue of blood, mixed with mucus, from mouth during efforts of coughing; emphysema; deeply-fixed pain in the chest; irritation of larynx and spasmodic cough; difficulty of breathing. But the shock, sudden collapse, or fainting, may occur with any severe wound. The escape of blood and air through external wound may take place in consequence of a wound of intercostal or mammary artery by air having been drawn into the cavity of the thorax during each expiration, expelled during inspiration, and driven into the blood. The issue of blood from the mouth, mixed with air, is looked upon as satisfactory evidence of wound of lung; but it may arise from other causes unconnected with the wound, and may therefore exist without a lung wound.

*Emphysema*, which was considered by older surgeons to be proof positive of a wound of the lung, is now looked upon as a complication which may be caused by the admission of air into the chest through the external wound, and not finding ready egress during respiration, passes into the cellular tissue, in the immediate neighbourhood of the external wound, and therefore cannot be considered as a diagnostic symptom of any value.

The pain in the chest, cough, irritation of larynx, and difficulty of breathing, with the continuance of blood in the mouth, or blood, and especially *mucus*, from the wound, may be considered the most reliable symptoms.

When the wounds occur in civil life, the weapon causing the injury might be procured, and a certain amount of assistance afforded by examining it, and judging of its extent by the stains of blood on it; but in war there is no such help.

It has been recommended to test the wound by holding a lighted candle opposite to it, and direct the patient to take a deep inspiration, when, if the candle is blown out, it is a proof that the lung has been wounded.

*Use of Probes in Chest Wounds.*—The introduction of the finger or a probe may afford the desired information; with the former there may be great difficulty, as the wound may be small, and the space between the ribs

not admit of the finger passing. The latter expedient is not considered judicious—in fact, it has been condemned by most competent authorities, and justly so.

Dupuytren considers that a probe ought never be used in a wound of the lung. It is, he says, the greatest fault that can be committed in surgery, and the instrument called chest probe that one finds in cases of instruments ought to be banished, at least for this sort of lesions.

Mr. Poland says: "Exploration by means of the finger, probe, sound, or other instrument, were this to be permitted, and a careful and minute examination made by the introduction of the finger into the wound, an easy diagnosis would at once be realized; but in wounds of the chest, as in wounds of the abdomen, all manipulative examination is to be denounced as perfectly unwarrantable, being attended with highly dangerous results, by disturbing Nature's efforts to effect a repair, disarranging the clot, and exciting irritation and inflammation—a proceeding only tending to gratify curiosity, without the slightest benefit to the patient."\*

*Treatment of Penetrating Wound.*—On first seeing a patient with a penetrating wound of the chest, an endeavour should be made to restore animation by the administration of beef-tea and cordials. Should reaction take place, distressing symptoms will cease; hæmorrhage may have been checked, and with a suitable bandage round the thorax it is possible no bad symptoms will follow; but blood may continue being poured out in the cavity of the chest, causing pressure on the lungs, and consequent symptoms of distress, or it may come through the external wound, flooding the sufferer.

*Blood in Cavity of Chest.*—If the blood is being poured into the cavity of the chest, the surgeon will be warned by the cold perspiration, the pallid countenance, faintings, the weak pulse, and distress in breathing. If he examines the chest, he will find it enlarged on the injured side, intercostal spaces bulging out.

There will be dulness in proportion to the amount of cavity filled up. There will be no respiratory murmur, the lung being pressed down. Succussion may afford proof of the presence of blood in the chest.

*Ecchymosis* is laid down as a symptom or sign of effusion of blood within the chest at a late period. Valentine considers it to be a pathognomonic sign of effusion of blood. He says: "It is very dissimilar to that which occurs after a blow or wound, and which takes place shortly after the accident, being around the wound if there be one, and extending from it. The patient also complains of pain when the bruised part is pressed by the fingers. These characters are not observed in the ecchymosis, the sign of effusion, which always takes place near the angles of the lower or false ribs, descending towards the loins. Its colour is identical with that which

\* Mr. Poland on 'Injuries of the Chest,' Holmes's 'System of Surgery,' vol. ii. p. 579.

appears on the abdomen of persons some time after death—a bright violet (*violet très-éclairci*). It appears about ten days after the receipt of the injury—sometimes later.”\* Should the blood come through the external wound, the diagnosis is simple enough.

*Treatment for Hæmorrhage into Cavity of Chest.*—It now becomes a matter of serious consideration what is the best line of treatment for this form of hæmorrhage; but before taking it for granted that it is coming from the lungs, an endeavour should be made to try and discover if the intercostal or internal mammary arteries have been wounded. And as a guide to this, it has been remarked that when there is internal hæmorrhage from the latter sources, the symptoms are more gradual than if the blood comes direct from the lungs or pulmonary arteries.

In the event of the hæmorrhage coming from mammary or intercostal arteries, an attempt should be made to tie these vessels, or otherwise close them, for which purpose various plans have been proposed, some of which may be mentioned here:—

Pass a curved needle, armed with a ligature, completely round the rib, and compress the wounded artery by means of a pledget placed over orifice and included in ligature.

The employment of agarici or sponge, with continual compression by hands of successive assistants.

Professor Longmore describes “Desault’s purse,” which is a mode of compression, and is as follows:—“Place a piece of linen on that part of the chest at the wound. The middle portion of the linen is pressed by the finger into the wound, so as to form a kind of pouch. This pouch is then distended with sponge or lint pushed into it, till it arrests the bleeding. On stretching out the corners of this linen cloth, the pressure of the plug will be increased. The whole may be secured to the chest by a roller or bandage.”†

Mr. Guthrie considers that wounds of the intercostal arteries rarely give rise to hæmorrhage, so as to require a special operation for suppression; but whenever it does so happen, the wound should be enlarged, so as to show the bleeding orifice, which should be secured by one ligature if distinctly open, and by two if the vessel should only be partially divided. The vessel is sometimes so small as to be easily twisted, or its end sufficiently bruised as well as twisted, to arrest the hæmorrhage.‡

It having been pretty well ascertained that hæmorrhage is from the lung, and the symptoms being urgent, what measures should the surgeon adopt? Many opinions have been expressed on this important and difficult subject.

\* Guthrie’s ‘Commentaries,’ p. 459.

† ‘Gun-shot Wounds,’ by T. Longmore; Holmes’s ‘System of Surgery,’ vol. ii., p. 199.

‡ Guthrie’s ‘Commentaries,’ p. 518.



Hennen recommends that the surgeon's first object be to diminish the quantity of circulating blood, the quantity removed being governed by condition of patient. He says: "If a man is wounded in the chest, let him lie quietly along, and lose from thirty to forty ounces of blood; remove clothes, examine with finger and extract everything within reach, whether cloth, ball, iron, wood, splinters of bone, or clots of blood. If the orifice is not sufficiently large, we must not be afraid of making it moderately larger by a cautious use of a probe-pointed bistoury."

If the patient survives the first three days, hopes may begin to be entertained of his recovering the immediate effects of the hæmorrhage; the danger then to be apprehended is not from hæmorrhage, but from inflammation of the lung and pleuritic effusion.

Ballingall says, when hæmorrhage arises from the lungs themselves, we have no efficient means of commanding it, and can only obviate it by general depletion, and thus diminish the quantity of blood passing through the lungs. It must be boldly pushed to the utmost limit.

Mr. Guthrie advocates the following measure:—"The right course is, I apprehend, to remove all the blood which can be evacuated by position, provided it can be done without danger to the patient, rather than to allow it to fill the chest; but as the bleeding vessel in the lung cannot readily be got at, if seen, nor be secured by ligature with advantage, it is advisable, if the bleeding continue, to close the wound, and allow the cavity of the pleura to be filled, until the lung shall be sufficiently compressed to cause the hæmorrhage to cease, if the person survive so long.

"The first object is to save life; after that, if time be given, the next will be to relieve the loaded cavity."

Mr. Longmore recommends that "hæmorrhage from the lung itself must be treated on the general principles adopted in all such cases: the administration of cool acid drinks, iced—if ice can be obtained, perfect quiet, and the administration of opium or digitalis.

"When blood has accumulated in any large quantity, and the patient is so much oppressed as to threaten suffocation, all coverings must be removed, and the blood permitted to escape by wound; the wound should even be enlarged, if necessary, so as, with the assistance of proper position, to facilitate its escape. If the effused blood, from the situation of the wound, cannot be thus evacuated, and the patient be in danger of suffocation, then paracentesis must be resorted to."

Dr. Macleod, who had considerable experience during the Crimean War, says that those cases did best in which early, active, and repeated bleedings were had recourse to.

Mr. Poland recommends repeated bleeding, with a view to making a sudden impression on the general system.

The Report of the Surgeon-General, American Army, on the treatment of



chest wounds during the War of the Rebellion, is of the greatest importance ; and from the vast number of cases, amounting to 20,264, the success in the treatment without venesection should be a great lesson to the army surgeon, and enable him to decide as to the proper course to be adopted in such cases.

The following is an abstract of the measures used for the different descriptions of wounds :—

In injuries of the thorax, whether attended or not by breach of surface, rest, a comfortable position, and a broad bandage round the chest.

After stanching the bleeding, cleansing the parts and removing foreign bodies, the further conduct of the surgeon must be governed by the extent and nature of the lesion. All superficial wounds should be closed, with a view to early adhesion. In extensive incisions or lacerations, use sutures or “*serre-fines*,” but in coughing or movements these are apt to be torn out.

In penetrating wounds some preferred to support the injured side with broad strips of plaster ; this was considered a secure dressing, and acceptable to the patient. The starch bandage was used, but its application was not found convenient.

When the discharges were profuse, carded oakum was used.

In profuse primary hæmorrhage the bleeding was arrested if possible by ligature or compression, but when impossible to reach the source of the internal bleeding, it was considered best to close the wound and to promote occlusion of the bleeding vessel by general means.

In the general treatment the uncomplicated non-penetrating wounds required no exceptional measures beyond restriction of diet and the means necessary to insure rest.

In penetrating wounds venesection appears to have been abandoned altogether ; hæmorrhage was treated by the application of cold, perfect rest, and the administration of opium.

These measures, he says, seem to have proved adequate generally.

Dr. Chisholm's views are given in the Surgeon-General's Report. He deprecates venesection in chest wounds ; even when the lung is inflamed he prefers the mild antiphlogistic and expectant treatment to the spoliative. The large success in the treatment of perforating chest wounds in the Confederate hospitals puts forth in strong light the powers of Nature to heal all wounds when least interfered with by meddlesome surgery. Absolute rest, cooling beverages, moderate nourishment, avoiding over-stimulation, with small doses of tartar emetic, veratrum or digitalis, the liberal use of opium, and attention to internal secretions will be required in all cases ; and in most will compose the entire treatment.

Among the pharmaceutical preparations employed by the American surgeons was opium, which appears to be the one on which most reliance was placed ; but care should be observed in its administration, as hæmor-

rhage tends to increase its action. It quiets the nervous system, and indirectly moderates hæmorrhage.

Stromeyer, in his 'Experiences of Gun-shot Wounds,' of 1866, remarks, under the head of Wounds of Thorax, that, "with the exception of a single instance of venesection which was at his own suggestion, there was no bleeding for chest wounds." How far it might have been desirable in exceptional cases, he cannot decide, but adds: "It is assuredly to be deplored if, by omitting bleeding, so little attention is paid to the remainder of the treatment." He frequently discontinued wine and coffee, which acted as stimulants, and ordered the patient to take whey, and, later on, cod-liver oil. "It is only through tranquillity and prudent nourishment that the dangers of chest-wounds can be avoided."\*

Legouest objects strongly to bleeding for wounds of lungs, as being more injurious than useful. He thinks it is better to close the wound, have recourse to exterior stimulants, local application of refrigerants or ice. If hæmorrhage continues in the cavity of the chest, the wound must be opened if closed, and if too small to admit of evacuation of blood it must be enlarged; should this enfeeble the sufferer, the wound should be re-closed. The patient should lie on the affected side, with a light bandage round the chest.†

In former days excessive bleeding for hæmorrhage from the lungs, the result of a wound, was the general and established practice; but at the present time, and since the Crimean War, quite the opposite has been and is most in favour; in all probability due to the exertions of the many distinguished and thoughtful surgeons who served in that war. The course now recommended is to close the wound, allow the cavity of pleura to fill with blood, in view to compression of the wound in lung, and thereby close the vessel; but should great distress and difficulty of breathing supervene, place the sufferer on the wounded side and allow the blood to come away; and if the wound is not sufficiently large for this purpose, carefully extend it. Should there be two wounds, the uppermost should be closed.

Ice, refrigerating drinks, dilute sulphuric acid and opium, acetate of lead or ergot, may be administered, the patient being placed in a cool room, with little or no food and no stimulant whatever. In strong and healthy young soldiers, with great distress of breathing, relief may be afforded by venesection, as practised by Dr. Muir, now Sir William Muir, in the Crimea,‡ assisted by antimony and ipecacuanha, and the consecutive inflammation of lungs or pleura mitigated or obviated. Should inflammation or effusion take place, and the sufferer be attacked with the usual symptoms of pneumonia or

\* 'Experiences of Gun-shot Wounds,' p. 42. By Dr. L. Stromeyer. 1866.

† 'Traité de Chirurgie d'Armée.'

‡ 'Longmore on Gun-shot Wounds,' p. 202; Holmes's 'System of Surgery,' vol. ii.

pleuritis, it has been recommended (but on this point opinions differ) to resort to bleeding.

Guthrie says: "The first and most essential remedy in the treatment of pleuritis and pneumonia from injury is bleeding, which should be resorted to in every case, whenever the febrile excitement is really inflammatory. All old people, under such circumstances, unless in a cachectic state, bear at least one bleeding well; they often bear more, and no fact is more important, in opposition to the opinions commonly entertained on this subject. In young people, who have not been reduced in health and strength by privations and hard service, the bleeding should be repeated until the desired object has been effected; the quantity required to be drawn in inflammation, particularly after injuries, is very great. It may almost become a question, in some cases, whether a patient shall be allowed to die of the disease, or from loss of blood; for convalescence is rapid in proportion as the inflammation is of small extent, and has been early subdued.

"Bleeding in inflammation of the pleura, in *young and healthy* persons, should therefore be effected with an unsparing hand, until an impression has been made on the system—until the pain and the difficulty of breathing have been removed—until the patient can draw a full breath, or faints; and the operation should be repeated, from time to time, every three or four hours, according to the intensity of the recurrence, or the persistence of the essential symptoms."\*

Dr. Fraser, in his work on wounds of the chest, endeavours to point out the inutility of blood-letting for wounds of the lung, and subsequent inflammation. He remarks: "Inflammation, as the term is generally understood, is a most rare event in lung wounds; and consequently venesection is uncalled for, often injurious, and sometimes dangerous."

The cases which demand bleeding are those in which the pulse conveys to the finger of the medical man the sensation of a full, labouring, and oppressed pulse. The experience of the writer is that soldiers, when campaigning, can ill spare blood, especially if much has been lost from a wound or wounds; he therefore considers that the administration of antimony and a strict observance of diet and temperance, warm applications to the chest, will reduce the inflammation if it is to be done at all.

In civil life, Mr. Erichsen observes, that in healthy subjects, if inflammation be confined to the lungs, and attended by much dyspnoea, venesection will often give much relief.† The army surgeon may therefore class young soldiers at the beginning of a campaign with the patients alluded to by Mr. Erichsen.

With regard to the effects of a gun-shot wound of both lungs, many

\* Guthrie's 'Commentaries,' p. 411.

† Erichsen's 'Science and Art of Surgery,' vol. i., p. 497, 6th edition.

cases have been reported of recovery when both lungs have been penetrated, and dissection has proved that sufferers have lived for several days ; but the probability is that health will never be permanently restored after such an accident.

*Hermetically sealing penetrating wounds* of the chest was proposed by Assistant-Surgeon B. Howard, U. S. Army, but the process does not appear to have been approved of by the Surgeon-General, or other military surgeons. The former considers the indiscriminate application pernicious. Mr. Howard's plan is as follows :—

"Clean the wounds of all clots, splinters, and extraneous matters ; pare the edges and retain them in accurate apposition by means of metallic sutures ; carefully dry the wound and parts immediately surrounding it ; place thereon a few shreds of charpie arranged crosswise, after the manner of warp and woof ; pour on the charpie a few drops of collodion, so as to saturate it and form a sort of collodion cloth ; let it dry, then apply one or two additional coats of collodion with a camel's hair pencil, and repeat the process, until satisfied that the wound is hermetically sealed."\*

On the plan of hermetically closing wounds, Deputy-Surgeon-General Gordon remarks, with regard to its application during the siege of Paris :—

"It is true that the method of treating gun-shot wounds of the chest, as practised by Dr. Swinburne, and followed by Dr. Howard in the American War, is condemned by some surgeons. It is beyond question, however, that the results obtained from it in the ambulance in the Avenue de l'Impératrice during the siege were very satisfactory, so far as they went, and of a kind to justify its further adoption. It seems to me, therefore, that in future wars the treatment indicated is this :—Provided the bullet passes completely through the chest, close the opening as Dr. Swinburne did, and so treat the patient. If, however, from accumulation of fluid or subsequent suppuration, not only may it become necessary to allow the contents of the pleura free egress by the original wounds, but openings in dependent positions may have to be made with a view to give egress to the discharges."†

*Extraneous bodies in superficial chest wounds* should be carefully removed, splinters and spiculæ of bone elevated or removed if detached, and in the event of a ball passing through or round the chest, but not having sufficient velocity to make an exit at the opposite side, being possibly impacted between two ribs, or fracturing a rib, and presenting itself as a small tumour under the skin, it will be necessary to observe great caution in attempting to remove it, as by want of care it may be forced back and

\* 'Reports of American War of Rebellion,' p. 497.

† 'Lessons in Hygiene and Surgery,' by Dr. Gordon, C.B., p. 138.

fall into the cavity of pleura, complicating matters very considerably; but if it is not causing distress, it is better not to interfere, as the missile may become encysted. The operation should be performed during inspiration.

When round bullets were used it was not an uncommon circumstance for a ball to strike a rib and pass half way round the chest, but with the conoidal bullet this rarely happens.

*Foreign bodies in cavity of pleura* generally give rise to fatal results, but cases are on record where extraneous bodies have been removed, and life of patient saved. The following circumstance may assist in forming a diagnosis as to the presence of such. A wound in chest wall, entering cavity without a wound of exit; lung not wounded; inflammation rapidly set up; auscultation or percussion—the latter should point out the exact position. Guthrie considers that “the presence of a ball, rolling about on the diaphragm, can now be ascertained by means of the stethoscope at an early period, so as to admit of an operation being undertaken with confidence for its removal; whilst the knowledge acquired by auscultation or percussion, of the filling of the chest by fluid, whether serous, bloody, or purulent, is at the same time incontestibly demonstrated.

“The presence of a ball, or of any other foreign body, decides the question as to the place where the opening into the chest should be made for its removal.”

*Searching for Extraneous Bodies in Chest.*—Authorities differ as to the advisability or otherwise of searching for extraneous bodies in the cavity of the chest. Bell, writing in 1800, says, “As for a ball itself, if it be lost in the thorax, it is irrecoverably lost, and no method that we can contrive will enable us either to find it or extract it.”\* With the present advanced knowledge of the science and art of surgery, there is little doubt but that a ball or other missile can be found in the chest, but the propriety of searching for it has not been advocated by many eminent authorities.

Baudens advises the introduction into the thorax, by the open wound where the projectile entered, of a probe, to ascertain the position of the extraneous substance. When that is reached, the point of the probe should be pressed down against the side of the chest, so as to point out its position, and an incision should then be made at the most convenient place.

M. Legouest, in speaking of the use of the probe, remarks: “The only inconvenience to which one is exposed in probing a gun-shot wound of the chest, supposing a foreign body to be in it, is not to find that for which one is searching. In fact, when the lung is free from adhesions it recedes with the pressure of the probe, and escapes injury; or if the lung adheres

\* ‘Nature and Cure of Wounds,’ by John Bell, vol. ii., p. 28.

to the pleura costalis, and the internal wound is in relation with the outer, in this case a chest probe or large gum elastic probe might be introduced into the course of the wounded lung without running the risk of causing more inflammation than the presence of the ball, splinters, clothing, or other extraneous matters." He agrees with Ledran that, if one is fortunate enough to find the extraneous matter in the lung, one must dilate sufficiently the exterior wound in order to seize it with pincers, and extract without obstruction.\*

Mr. Longmore mentions a very interesting case of transfixion of the right side of the chest and right lung by a lance, with recovery, showing the reparative powers of the lungs after serious if not apparently fatal injuries.†

Erichsen remarks on the subject of foreign bodies in the chest: "If any extraneous body, such as a bullet, a piece of wadding, or of clothing, have penetrated too deeply into the chest to be readily extracted through the external opening, it would not be safe to make incisions or exploratory researches, with a view of extracting it, for though its presence would increase the patient's danger, yet attempts at extraction would not only add to this, but would in all probability be fatal. In many cases bodies so lodged become surrounded by an abscess, are loosened, and eventually are spat up, or appear at the external wound."‡

Surgeon Brinton, of the U. S. Volunteers, observes that "greater danger attends fractures of the ribs at the point [of entrance of missile than those at the point of exit, a circumstance which can be easily accounted for by the probability of there being numerous spiculæ of bone injuring the pleura or lungs, whereas in the wound of exit the spiculæ pass outward." It is a circumstance which might guide the surgeon when called upon to give an opinion on such an injury.§

*Emphysema*, or the infiltration of air into the cellular tissue, is not a usual accompaniment of some wounds of the chest. It may be caused by a spicula of a broken rib penetrating the pleura and wounding the lung, or by wounds of the lung or bronchi, where air passes from lung into cavity of chest, and is forced into external wound; but to secure its taking place in this latter description of injury, it is necessary that the external wound and wound of lung should not exactly correspond, but have an oblique direction.

It may also be caused by air entering the chest on inspiration through an external wound, and, finding some obstruction on being forced out again at expiration, diffusing itself into the cellular tissue.

\* 'Traité de Chirurgie d'Armée,' by L. Legouest, p. 357.

† 'Army Medical Department Report for 1869,' p. 508.

‡ 'Science and Art of Surgery,' by Erichsen, vol. i., 6th ed., p. 498.

§ 'Reports on War of Rebellion,' p. 488.



Mr. Hennen's experience of this complication was that it occurred in about one in fifty cases of wounds of the chest, and that it is more frequent in confined punctured wounds than in free and open.

Mr. Guthrie is of opinion that it is not so frequent an occurrence as was at one time supposed. He says: "An opening made by a musket-ball rarely admits of emphysema. A slanting wound made by a pistol-ball may sometimes give rise to it. After a long tortuous wound made by swords or lances, it is seen more frequently, but then it takes place shortly after receipt of injury."

Legouest considers it one of the most frequent accompaniments of piercing wounds of the chest.

Emphysema appears in some slight injuries, as, for instance, a fractured rib. When a small spicula of bone has penetrated lung, causing emphysema in the immediate neighbourhood of wound, the air will in all probability be soon absorbed by the application of a bandage, or wide strips of plaster round the chest. While serving in India, the writer was called upon to visit a brother officer who had been thrown from his horse and fractured three ribs. He was scarcely able to breathe; there was great pain and considerable emphysema in the immediate vicinity of the broken ribs. A bandage was applied pretty firmly round the chest, when distress in breathing disappeared, and the emphysema subsided in a few days.

Bandaging and strapping must be regulated by the sensation of the patient, and, should either cause distress, be at once removed.

Should the swelling extend, so as to interfere with respiration, the external wound, if there be one, should be opened, and punctures or scarification made in the cellular tissue.

If emphysema is produced by the air being drawn into the cavity of chest through a wound, and then forced into the cellular tissue, the wound should be closed.

In penetrating wound of lung, when the external wound and that in lung are not opposite to one another, the outer wound should be made to correspond with the inner. Larrey recommends incisions, followed by the application of cupping glasses.

Legouest says, that when emphysema is considerable recourse must be had, as recommended by Malgaigne, to making numerous punctures in different places with the lancet, long and deep incisions being useless; the air escapes easily and spontaneously by small incisions, its exit being favoured by depressants.

The application of scarificators, cupping glasses, may be useful; but they will draw a certain quantity of blood as well as air, which may not be necessary. Should there be pulmonary congestion as well as emphysema, relief may be obtained by venesection and the administration of ipecacuanha and antimony.



*Pneumothorax*, or an accumulation of air in the cavity of the pleura, gives rise to the following symptoms: dyspnoea, tympanitic resonance of chest, amphoric respiration, metallic tinkling on auscultation, affected side dilated. The patient feels relief by lying on his back or affected side, seldom on good side.

Relief must be given by reopening the wound in chest, if one exists, or removing the air by trochar and canula.

*Hernia of the Lung or Pneumocele*.—This complication may occur immediately after receipt of injury, while the chest wound is open or when it has healed. This latter is a rare occurrence, but may take place when the intercostals have been much injured and weakened. It has been known to occur from fractured ribs, without any wound, the pleura and intercostal muscles having been ruptured. This description of hernia should be treated by supports, the tumour having been pushed back. When there is an extensive wound of the chest, it may occur by violent efforts in coughing or in expiration.

The tumour presents a livid appearance, and if not soon returned will become gangrenous. It is resonant on percussion, and if a stethoscope is applied to it a crackling or rubbing sound will be heard. It may be removed by the knife or by ligature, or, if small, may be returned, provided it has not been strangulated.

Mr. Guthrie recommends: "It should be allowed to remain, or be only so far returned, if it can be so managed, as to rest within the edges of the divided pleura, and fill up the gap made by the incision, over which the integuments should be accurately drawn and retained. The adhesion of the lung to the pleura costalis arrests the inflammation, and may prevent its progress in other parts of the cavity.

"Whenever the protruded lung has been completely returned, more inflammation has followed than where it has been allowed to remain under the precautions recommended. The protruded lung, when left uncovered and unprotected, soon loses its natural brilliancy, dies quickly, shrinks, and becomes livid, without being gangrenous. In such cases, the protruded part may be removed; but it should never be separated at its base from its attachment to the pleura costalis by which it is surrounded."\*

M. Legouest recommends that the tumour be allowed to fall off itself, and advises dressing in the ordinary manner, protecting the parts from injury and preventing inflammation. Above all, to repair the lesions which have favoured the formation of the rupture.

*Wounds of the Pericardium or Heart*.—These injuries may occur from severe blows on the chest, by puncture, stab, or gun-shot. The pericardium may be injured, and the heart escape.

When the pericardium is injured, the patient appears in a state of collapse,

\* Guthrie's 'Commentaries,' p. 499.

or death takes place immediately. The former is usually followed by inflammation, oppression, dyspnoea, great appearance of distress, small pulse, and pain at the seat of injury. The wound should be closed if large; sufferer kept perfectly quiet, and strict antiphlogistic treatment enforced.

*Wounds of the Heart.*—When the heart is wounded, the injuries may not penetrate into the cavities. Instances have been known where foreign bodies have lodged and become encysted in the structures of the organ.

In penetrating wounds the results have been immediately fatal from loss of blood and shock, but sufferers have lain for several days in consequence of the wound closing by contraction, or the lodgment of a coagulum preventing effusion of blood into the pericardium or pleura.

“It is recorded that in cases which immediately prove fatal, the wounded man appears to spring off the ground, or falls dead without convulsion or apparent knowledge of being injured. If the injury does not prove fatal immediately, there will be collapse, followed by great distress and oppression of breathing, anxious countenance, pulse very weak, pallid face. Subsequently there may be all the complications of inflammation of the endocardium.

“The external wound should be accurately closed and all escape of blood prevented, provided, in doing so, suffocation is not induced by blood filling the cavity of the pericardium or pleura, in which case relief may be obtained by allowing some blood to escape.”

Inflammatory symptoms should be treated by local bleeding and internal administration of mercury. It has been recommended by Larrey to open the pericardium, in the event of it becoming full of blood or serum preventing the movements of the heart, by the following operation :—

“An oblique incision is to be made from over the edge of the ensiform cartilage to the united extremities of the cartilages of the seventh and eighth ribs. The cellular tissue being divided with some fibres of the rectus and external oblique muscles, there remains only a portion of the peritoneum, called its false layer, above the pericardium, which can be seen after the division of all the intervening cellular tissue, projecting between the first and second digitations of the diaphragm. Into this the bistoury is to be entered, with the precaution of doing it with the edge turned upwards, and directed a little from right to left, to avoid the peritoneum. The smallest portion possible of the anterior border of the diaphragm is next to be divided, where it is attached to the inner part of the cartilage of the seventh rib; the internal mammary artery is to the outside. The patient should be placed perpendicularly, and supported on his bed, which inclines the anterior part and base of the pericardium to the fore-part of the chest.”\*

“Skielderup recommends this operation to be done by first trepanning

\* Guthrie's ‘Commentaries,’ p. 512.

the sternum a little below the spot where the cartilage of the fifth rib is united to that bone, at which part the periosteum lining it offers considerable resistance, and should not be divided by the trephine. Below this there is a triangular space formed by the separation of the layers of the mediastinum, free from cellular tissue, and tending a little more to the left than to the right."

*Wounds of the Diaphragm.*—John Bell, in speaking of these wounds, remarks: "Though wounds of the diaphragm are not material in themselves, yet the diaphragm can hardly be touched but in mortal wounds, i.e. in wounds touching both cavities, viz., of the thorax and of the abdomen, when most frequently the stomach, lungs, pericardium, or heart, are either wounded or are soon inflamed, and so drawn into disease."

The surgeon may recognise these wounds, first by the position of the injury in either chest or abdomen, and if there are evidences of a missile or weapon having penetrated; also by the following symptoms—hiccough, spasmodic or jerking breathing, pain in the top of shoulder, or loss of power in the arm. There may be nausea or vomiting, and if the liver has been injured, jaundice may appear. If the stomach or intestines have been wounded, blood will, in all probability, appear, either by vomiting or in the stools.

"A wound of the diaphragm may give rise to a hernia in the chest; it will, therefore, be necessary for the sufferer to remain in the upright position during the process of recovery, to avoid bending as much as possible; and, in the event of recovery taking place, care should be observed in eating small quantities and standing erect after meals, avoiding bending or straining, as a wound of the diaphragm is supposed never to close except under rare and peculiar circumstances. A patient, therefore, once wounded would always be liable to hernia."

Hennen says: "Of the wounds of the diaphragm I have never met one unconnected with injuries of one or both cavities which it divides, or in which symptoms of their being affected did not appear; although I have met with one instance where a musket-ball passed along from the sternal to the vertebral connection of that septum, precisely following the curvature of the ribs. The prevention of inflammation is the leading indication of cure; but injuries are frequently found on dissection, which were not at all indicated during life by any peculiar symptom."\*

An operation for the relief of this hernia has been proposed by Guthrie, which, though formidable, he says cannot be compared as to danger with the incision of twelve or fourteen inches long through the walls of the abdomen, which has been in some instances successfully made for the removal of diseased ovaria.

The opening should be a straight incision through the wall of the abdo-

\* Hennen's 'Military Surgery,' p. 479.

men, large enough to admit the hand immediately over the part where the diaphragm is supposed to be injured. It should be closed by a continuous suture throughout the skin.

*Empyema*.—This disease is the result of high inflammation of the pleura, especially if the constitution is weak, or of the lodgment of a foreign body or blood in the cavity of the pleura, giving rise to inflammation. It may occur as a collection of serum or pus mixed with lymph and blood.

The disease may be recognised by dulness on percussion where the fluid has collected, dyspnœa or difficulty of breathing, absence of respiratory murmur at the lower and posterior part of the chest corresponding to where the fluid has reached the pleural cavity, and, of course, influenced by the position of the patient.

There will be *ægophony* at the upper part of the lung.

If the effused fluid has filled one side, that side is enlarged; the ribs are immovable and partly raised; the intercostal spaces will be more or less filled up, and the surface of the chest will be found smooth. There will be absence of all breath or voice sounds.

The lung may become pressed against the spine, and, if the left pleura be filled, displacement of the heart may take place to the right side; or, if the effusion is to the right side, the liver may be pushed down below its normal level.

There may be œdema of the back, which was looked upon by the older writers as distinctive of effusion into the chest. There may be cough, but it has no characteristic feature in connection with empyema.

Should the application of counter-irritants and general improvement in health not relieve the patient, the fluid must be relieved by an operation. This in olden time was done with the knife, hot iron, or caustic; and until recently the operation was performed with the trochar and canula originally recommended by Ambrose Paré. But now there is a more convenient and admirably adapted instrument in Dr. G. Dieulafoy's Aspirator, whereby fluids can be removed from the chest, liver, or elsewhere, without the possibility of air reaching the seat of disease. I have had several opportunities of witnessing the removal of large quantities of pus from the chest with this instrument, when not the slightest unpleasant symptom followed.

*Place of Election for Tapping the Chest. Paracentesis Thoracis*.—All practical surgeons agree, that the operation should be performed between the fifth and sixth ribs, counting from above, and between the sixth and seventh from below, and at one-third the distance from the spinous process of the vertebra, or two-thirds from the middle of the sternum.

When an external swelling indicates the presence of matter which may be the result of inflammation, induced by the lodgment of a ball or ex-

traneous body in the chest, an opening should be made into the tumour, which is called the "operation of necessity."

In introducing the point of the trochar, with which the aspirator is adapted, care must be taken not to wound the intercostal artery; it is therefore best to keep the point of the instrument nearer the lower than the upper rib, and to press it forward rather quickly so as to avoid pushing the pleura before it.

The admission of air into the cavity of the pleura should be prevented if possible, as in unhealthy constitutions it may give rise to great mischief. If, however, it should find its way in, which it does in most cases where Dieulafoy's aspirator has not been used, the wound should be kept well closed, and the air will in all probability be absorbed.

With regard to injecting stimulating or simple fluids into the cavity of the chest, warm milk or water has been recommended, particularly when foreign bodies have been keeping up irritation, which may be brought to the opening by sudden removal of fluid.

When the fluid is purulent, a permanent drain should be established. This may not take place till after the operation for removal of serum has been repeated several times.

Hennen remarks, "If the symptoms of effusion of purulent matter succeed the original wound within a short period, the site of the injury, as chosen by some surgeons, is the most proper point of puncture. If the empyema is formed at a more distant period, the spot of election, as it is called, or between the sixth and seventh true ribs, is preferred. I should recommend a point considerably below the original wound, as adhesions, either general or partial, are apt to form in its neighbourhood. I have observed great relief to follow this operation; but I have also seen a removal of all the pulmonic symptoms take place, and death very frequently ensue, shortly after the puncture. Nature sometimes makes an effort for the removal of the fluids effused in cases of empyema, by distant channels; but the instances are rare and not often successful."\*

*Hydrothorax* may occur as the result of constitutional dropsy or gunshot wounds, and require surgical interference, as in empyema; the operation of paracentesis thoracis being necessary. Its presence is recognised by those general signs which indicate the presence of pus or blood in the cavities of the pleura. Hamilton says it may be distinguished from hæmothorax in being preceded usually by the sign of pleuritis or of pleuropneumonia, in the absence of those symptoms of prostration which must necessarily accompany large bleedings, and in the greater facility with which the contained fluid flows from one point of the cavity to another on change of position.†

\* Hennen's 'Military Surgery,' p. 414.

† 'A Treatise on Military Surgery and Hygiene,' by F. H. Hamilton, M.D., p. 287.

## WOUNDS OF THE ABDOMEN.

*Classification of Wounds of Abdomen.*—These wounds are usually divided into penetrating and non-penetrating; but some authors divide them into wounds affecting the walls, wounds extending into the cavity, and wounds or injuries of contents of abdomen.

For convenience of description the former is no doubt the best.

The danger to be contended with in all wounds of the abdomen is peritonitis, and of course the greater extent of injury, especially internal, the greater probability of this formidable complication attacking the sufferer.

*Non-penetrating wounds uncomplicated* with injury of the internal viscera require no special line of treatment. If there are incisions or lacerations, the parts should be adjusted and kept in position by means of sutures, or stitches introduced through the skin only. The position of the sufferer during treatment should be such that the muscles of abdomen are relaxed, as without it is impossible for union to take place by adhesion.

A bullet may strike the abdomen obliquely and pass between the muscles and the skin, or between the peritoneum and the muscles, giving rise to alarming symptoms, causing violent pain, vomiting, and general derangement, followed by extensive peritonitis or suppuration.

In the event of suppuration, an early opening should be made to prevent the possibility of pus perforating the peritoneum.

Should a bullet or other missile be lodged deeply in the abdominal walls, and cause no inconvenience, it is better to let it alone unless it prove troublesome.

*Complicated non-penetrating wounds*, the result of contusion, may be accompanied by extensive injuries to some of the viscera or bones, and are generally the result of wind-balls, explosions, or the passage of the wheel of an artillery-waggon or gun-carriage over the body. Death generally results in a very short time from shock, hæmorrhage, or peritonitis, or subsequently from sloughing, or abscesses in the abdominal walls.

The shock in these cases is of the severest description, amounting in some instances to prolonged collapse. The writer on a recent occasion saw an instance of an artilleryman being thrown from the limber while in rapid motion, a wheel passing obliquely over the abdomen and pelvis; he was immediately attacked with prolonged collapse, vomiting, pains, bloody



urine, and great restlessness, from which he never rallied, and expired in a few hours.

The *post-mortem* examination gave evidence of extensive hæmorrhage into the peritoneal cavity, it being full of large clots. There was a fracture of the left ramus of ischium and pubes.

There was no external wound of any consequence; the skin being only a little congested where the wheel had passed over it.

In severe contusions there may be extensive injury of the viscera, which is most serious.

*"Rupture of the liver* is by no means speedily or even necessarily fatal; it may be, and usually is so, from great extravasation of blood or bile; but when this is not largely poured out, the patient may live for a considerable time, though he may eventually succumb to traumatic peritonitis."\* The injury may be recognized by the pain over its region, bilious vomiting, collapse, dullness on percussion, followed by peritonitis and jaundice.

*If the stomach is ruptured*, there will be bloody vomiting, followed rapidly by peritonitis.

*When the kidney is ruptured* there will be excessive collapse, pain referred to the lumbar region, retraction of testicle, and very likely, pain in the testicle itself and low down in the abdomen; numbness in upper part of thigh, bloody urine, frequent desire to pass water, and should the patient survive, there will, in all probability, be infiltration or extravasation into the sub-serous cellular tissue, which is more likely to occur in injuries to the posterior surface, and peritonitis in injuries of anterior surface.

Infiltration is soon followed by suppurative inflammation recognised by rigors, fever, dry brown tongue, and œdema of the parts in neighbourhood of injured kidney.

Should the kidney be severely contused, there will in all probability be albuminuria.

*The spleen being ruptured*, there will be great internal hæmorrhage, severe shock to the system, coldness of the surface, great anxiety, pain in the seat of injury, and death.

*In wounds of the intestines*, should the sufferer live long enough, the stools will be mixed with blood, the shock and collapse will be very great; but all these injuries are sometimes so connected with one another, that it is with difficulty any one particular injury can be identified. The part struck will be an assistance in pointing out the seat of mischief.

Wounds of the intestine are sometimes accompanied by emphysema of the abdominal wall, the result of escape of flatus from the wounded intestine. This symptom is characterized by an inelastic, doughy, puffy, crepitating swelling of the cellular tissue. In wounds which to all appearance

\* Erichsen's 'Science and Art of Surgery,' vol. i., p. 444.



are non-penetrating, or where there is no protrusion, this symptom is considered to be valuable in proving the existence of wound of the intestine.

In treating these injuries so briefly described, the first step should be to endeavour to restore the sufferer from the shock and collapse by keeping him very quiet, applying warmth to the extremities, and placing him in a comfortable position.

Measures should be used to try and prevent the approach of peritonitis and to check extravasation of blood into the abdomen. With severe pain, opium may be freely given. No stimulants should be given, in consequence of their liability to cause too much reaction and induce internal hæmorrhage.

*Penetrating wounds, with or without protrusion*, or injury of the viscera, are always attended by shock, and sometimes to a great extent.

With a small wound, such as from a bayonet or stab, it may be difficult to decide as to the existence or not of an internal injury; the surgeon should, therefore, be most careful in not introducing probes or other explorers, as he may inadvertently produce a most serious complication and form a simple wound into one of great severity. It is recommended that these injuries should be treated with light dressings, so as to permit of oozing, rather than apply pressure and cause extravasation among the deeper tissues. The sufferer should be on the lightest diet and without stimulants.

Should there be hæmorrhage of severe nature, and the wound not sufficiently large to allow the bleeding mouth of the vessel to be seen, Mr. Pollock recommends that the wound be enlarged until the wounded vessel can be seen and can be secured.

Pressure should never be applied for checking hæmorrhage in superficial abdominal wounds, on account of the blood being liable to find its way to cavities of abdomen or between the muscles and fascia, giving rise to deep-seated inflammation and suppuration.

*Penetrating wounds with injury of viscera* will be attended by great prostration, anxiety, restlessness, and, if the sufferer survives, in all probability by peritonitis.

*Protrusion of Intestine.*—If the wound has been made by cutting or lacerating instruments, or by a round ball or rifle bullet, it is generally followed by protrusion of some portion of contents of abdomen, the omentum, mesentery, or intestine being most usual. The protruded mass is always very large in comparison with the aperture from which it escapes, and is contracted very tightly by the lips of the wound. If left unreduced, the mass will soon become gangrenous from the pressure; it should therefore be cleansed, if soiled, and returned into the cavity of the abdomen, after which the wound is to be closed by sutures, which should include the peritoneum as well as other tissues.

Guthrie proposes, in the event of the protrusion being only omentum, that "it should be retained between the cut edges of the peritoneum, but without the slightest pressure or possible strangulation, in order that by its retention it may more readily adhere to these edges, and thus form a more certain barrier against the extension of inflammation than is likely to take place when moving at liberty in the cavity of the abdomen, however closely it may be supposed to be applied to the inner surface of its paries."\*

Erichsen suggests that the abdominal muscles should be relaxed by bending the thigh upon the abdomen, when the protrusion may be pushed back by steady pressure upon it, but no force should be employed; but if the parts cannot be reduced, the aperture through which they have escaped must be enlarged in the direction upwards. In replacing them, care should be taken that they are fairly put back into the cavity of the abdomen, and not pushed into the sheath of the rectus or in front of the peritoneum. The surgeon should not push the finger into the abdomen, but simply replace the protruded gut or omentum, and allow it to remain in the neighbourhood of the wound, to which it will contract adhesions.†

Mr. Pollock recommends that if the omentum be bruised, lacerated, dirty from contact with the ground or other material, inflamed or congested, or if the mass be not considerable, but there be much resistance to its reduction, without enlarging the wound, a ligature should be passed round the base of omentum, or a double thread be passed through it, and each thread tied round it, and the mass anterior to the ligature cut off and stump pushed back into the abdomen, the ligature being allowed to remain out.

If the protruded mass of omentum be very large and not injured, but the wound not sufficient to allow of a ready return, the wound should be enlarged, parts replaced; but if it be lacerated, bruised, or congested, it may be removed with safety. Its removal will be less serious than if left to suppurate in wound. The wound in abdomen should then be closed by means of sutures, care being taken that all hæmorrhage has ceased. The sutures should include the peritoneum, so as to secure perfect apposition of the edges of the wound and prevent entrance of intestine into space or gap which would be formed if the peritoneum were not included.‡

In returning protruded masses of omentum or intestine, great care and gentleness is required; if both, the latter should be pushed back first, and if strangulated, the cause of constriction must be removed.

*Protrusion of Stomach, Liver, Spleen.*—In extensive laceration of the

\* Guthrie's 'Commentaries,' p. 547.

† Erichsen's 'Science and Art of Surgery,' vol. i., p. 450.

‡ Holmes's 'System of Surgery,' vol. ii., pp. 663, 664, 667.

abdomen, the stomach, liver, spleen, and bladder have been protruded; these should be returned, having been first washed with tepid water.

*Protrusion of Bladder.*—When the bladder protrudes, it is recommended to pass a catheter, and by drawing off the urine much assistance will be afforded in its reduction.

*Gangrene of Intestine.*—Should the protruded part of an intestine become gangrenous from continued constriction and exposure, it should not be reduced, but an incision should be made through it, or the gangrenous part removed, so as to clear away the fæces and admit of an artificial anus, by attaching the edges to wound in abdomen.

*Injury of Protruded Intestine.*—Protruded intestine may be punctured, incised, lacerated, or completely divided; some difference of opinion appears to exist as to whether a small puncture should be interfered with; the proper treatment generally admitted is to pass a ligature through it, provided it is pervious to air or fluids, and prevent the escape of mucus or fæculent matter, which would set up peritoneal inflammation. If it is a mere puncture, it is often of no consequence and does not require treatment.

*Treatment of Wounds of Intestine.*—As a rule, all wounds of intestines should be closed by stitching, though at one time there were advocates for not doing so, as the stitches acted as foreign bodies, produced irritation, and did not prevent extravasation; the proceeding substituted being to form an artificial anus by returning the gut and causing the aperture to correspond with the wound in abdominal wall, the edges of both being brought into apposition and allowed to adhere.

Mr. J. Bell, in his Discourse on Wounds of the Belly, says: “When there is a wounded intestine which you are warned of only by the puffing out of the fæces, you must not pretend to search for it, nor put in your fingers, nor expect to sew it to the wound; but you may trust that the universal pressure which prevents great effusion of blood and collects the blood into one place—that very pressure which always causes the wounded bowel, and no other, to protrude, will make the two wounds—the outward wound and the inward wound of the intestine—oppose each other, point to point; and if all be kept thus quiet, though but for one day, so lively is the tendency to inflame, that that adhesion will be begun which is to save the patient's life.

“If, indeed, you have a wounded intestine fairly in your hand, protruding and plainly wounded, it were madness to let it go back into the abdomen, where there cannot but be some danger of the fæces getting out. But do not sew the bowel with a long suture, in hopes of closing the breach, nor follow the strange and whimsical invention of cylinders of paper or isinglass, which it is easier to use in experiments upon dogs than to practise in real wounds. You must make but one single stitch, and sew the wounded intestine to the outward wound; then the gut will adhere,

throw out its fæces for some time, and then heal, the outward and the inward wound uniting in one knot or scar."

He recommends that in a wound slit-like it is best "to make one simple stitch very lightly through the edges of the wounded intestine, not with the absurd intention of sewing up the breach in the intestine firmly with a needle and thread, but merely to keep the inward wound of the intestine neatly and closely in contact with the outward wound, when it will adhere,—will continue perhaps open, and throwing out its fæces for some time, but will contract gradually as the outward wound contracts, and will close effectually and soundly before the outward wound heals."

Mr. Bell further remarks: "As for intestines cut fairly across in all their circles, I believe the thing cannot happen, and that this, like the rest, is a piece of mere guess work; for if I know anything about the way in which the viscera are disposed within the belly, it must happen that a sabre which cuts one piece of intestine fairly across must have cut many other turns half through; and, in short, that a sabre cannot cut a piece of intestine across, unless the stroke have cut much of the belly, so much that, whether you finish with double row of stitches, or whether you use or neglect the elegant invention of the roll of tallow, is a matter of very little importance, but only that you had just as well spare yourself the trouble and let the poor man alone."

"But if it should happen that a gut is cut fairly across in all its circles, which is not impossible, but it may be, by a stab with a knife or broad sword, the mechanism of the case is this: the mesentery still has its hold upon each end of the divided intestine, and the two ends of the intestine can never be far separated from each other, nor can the one end be introduced so far within the other as to make the double row of stitches round and round, the one row distant from the other one inch. It is not by this thorough stitching that such a gut is to become sound; it is only by adhesions, and by two adhesions taking place at the same moment. The two ends of the gut may be made to adhere to each other, and the prudent way of favouring these adhesions is to introduce the one piece of intestine a little way within the other, and make one single small stitch in that part of the circle which is farthest from the mesentery, and then draw the gut by means of that thread close up to the wound; and thus it will probably happen that the mesentery will keep its side of the circle firm, that the stitch will keep the opposite side firm, that the gut being drawn by the thread, and pushed from behind, and flattened by the universal pressure within the abdomen, the double adhesion may take place—viz., of the surfaces of the intestine to each other, and of the wound of the intestine to that part of the inner surface of the belly where it is open and inflamed by the outward wound."\*

\* 'Discourses of the Nature and Cure of Wounds,' by John Bell, pp. 119, 120.

Guthrie recommends that "when an incised wound in the intestine is not supposed to exceed a third of an inch in length, no interference should take place; for the nature and extent of the injury cannot always be ascertained without the committal of a greater mischief than the injury itself. When the wound in the external parts has been made by an instrument not larger than one-third, or from that to half an inch in width, no attempt to probe or to meddle with the wound, for the purpose of examining the intestines, should be permitted. When the external wound has been made by a somewhat broader and longer instrument, it does not necessarily follow that the intestines should be wounded to an equal extent; and unless it protrude, or the contents of the bowel be discharged through the wound, the surgeon will not be warranted in enlarging the wound in the first instance, to see what mischief has been done.

"When the wounded bowel protrudes, or the external opening is sufficiently large to enable the surgeon to see or feel the injury by the introduction of his finger, there should be no difficulty as to the mode of proceeding. When the intestine is more largely injured, in a longitudinal or transverse direction, or is completely divided as far as or beyond the mesentery, the continuous suture is absolutely necessary."\*

Mr. Longmore recommends that when a protruding intestine is found to have been opened by a projectile, or to be gangrenous, the part so wounded should not be returned, but steps should be taken to try and form an artificial anus, so as to imitate the usual means of natural cure when recovery follows a gun-shot wound with penetration of intestine.†

Ballingall recommends M. Lambert's plan of operation for wounds of intestine: "A small stitch, including only the peritoneal coat of the intestine, is to be taken up on one side of the wound, at the distance of a line or two from its edge; the needle is then carried across the wound, and a similar stitch taken up on the opposite side at the same distance from its edge; in this way a number of ligatures are introduced at the distance of a quarter or half an inch from each other; and when these come to be tied, the wound is completely closed, the serous surfaces of the peritoneal coat on either side of the incisions are brought into contact, and the lips of the wound are left projecting into the intestinal tube."

Mr. Travers advocates the stitching up of a wounded intestine, and bases his opinion on the result of experiments which proved that when a wounded gut was sewn up and returned into the abdomen, the lymph was effused on the external surface of the bowel consequent on such an operation, and the stitches rapidly cut their way into the interior of the bowel and were passed away in the stools. He recommends that "a small sewing-needle, armed with silk thread, be passed near the lines formed at the base of the

\* 'Guthrie's *Commentaries*, p. 560.

† 'Longmore on Gun-shot Wounds,' p. 210.

everted lips. This thread is to be carried at short regular distances through the whole extent of the wound, the operator being mindful that an equal portion of the edges is included in each stitch. When the suture is finished, let the thread be securely fastened and cut close to the knot. The reduction of the collapsed fold should then be conducted with the utmost caution, and when completed the wound of the tegument should be treated with a stitch, a plaster, or a poultice, as circumstances dictate." Again, he says: "Whenever the suture is decided upon, it should be complete, the intestine should be returned fairly into the abdomen, and wound of parietes treated as if it had not extended beyond them."

Erichsen approves of stitching in suitable cases, but says: "If the wound

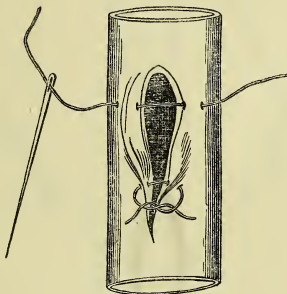


Fig. 58.

be very large and transverse, the result of gun-shot violence or other contusing force, no suture can be of any service, for not only might it be difficult to bring the edges together, but they would probably not cohere to one another, nor to abdominal wall." He considers punctured and incised wounds of moderate extent suitable, but is of opinion that much depends upon the way sutures are applied. The following is the proceeding he recommends in making the stitches: "They should be introduced by means of a fine round needle armed with sewing silk, in such a way that the peritoneal surfaces on each side of the wound are brought into contact. Adhesion takes place slowly between these, the wound in the other structure of the gut filling up by plastic deposits" (fig. 58); he considers it difficult to follow out the plan proposed, of the needle only penetrating the peritoneal



and areolar coats, no muscular tissue being taken up, and is of opinion that the safer plan is doubtless to carry the suture through the whole thickness of the gut, bringing the stitches out at about one-sixth of an inch from the edge of the cut in such a way that the serous surfaces are drawn into apposition. The ends of the stitches should be cut short close to the knot.\*

Mr. Pollock, in his essay in Holmes's 'System of Surgery,' in speaking of these wounds, observes that "a wound of protruded intestine or stomach, if small, should be secured by ligature; if large, by sutures; and protruded

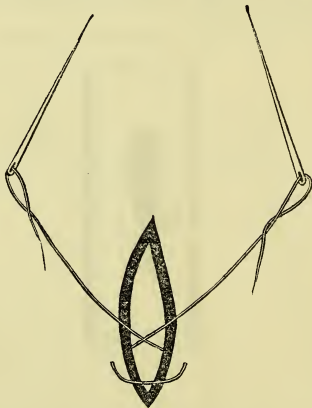


Fig. 59.

viscus returned into abdomen. The former lesion may terminate in recovery, 'but wounds amounting to direct division of the canal are irreparable,' unless artificial anus be established." He does not appear to lay any particular stress on the nature of the sutures in wounded intestines, remarking that some little fancy may be exercised in the choice of sutures; but that is a minor consideration.

*M. Lagouest recommends an ingenious plan of closing a wound in intestine, originated by Dr. Vézine, the knots of which are placed in the interior of the*

\* 'Science and Art of Surgery,' vol. i., p. 451.



gut. A fine thread, armed at both extremities with a common sewing-needle, is sufficient for the operation. The needle should penetrate two or three millimetres (one millimetre =  $\cdot 03937$  of an inch), on each side of the exterior and interior edge of the wound (fig. 59), and bring them out through the wound with the threads, which are passed twice round one



Fig. 60.

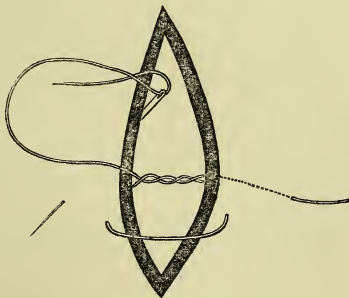


Fig. 61.

another to form the surgical knot (fig. 60). This knot is not tightened till later, but the needles are re-introduced successively into the wound and back through the intestine at a point about 10 millimetres further from the first knot, bringing back the thread with them (fig. 61). As many points of sutures are thus made as may be required.

In order to bring the edges of the serous membrane into apposition, it is necessary to draw tightly on the end of the thread, tie them, and cut them short at the point of exit.

Having given the opinion of some of the most eminent authorities on the subject of a wounded and protruded intestine, a summary may now be made as to what the surgeon should do. The parts should be thoroughly cleaned with a little tepid water, and if there is an incised wound, its edges should be brought together by means of sutures, that proposed by Travers being probably the most suitable. The intestine is then to be returned with great care to the abdomen, provided there be no contraction; but should such exist, the outer wound is to be enlarged.

The wound of abdomen must be treated as if the wound of intestine did not exist.

In the event of the wound of intestine being gangrenous or extensively lacerated, so that the edges cannot be brought together, or that they are injured, as by a gun-shot wound, the course to be adopted is to stitch the upper portion of intestine to abdominal wound, with a view to formation of an artificial anus. The position of the patient in all wounds of the abdomen is of the greatest importance; it should be so that the muscles are relaxed. The diet should be of the mildest description; no stimulant of any kind whatever should be given. The topical treatment should be bland and soothing, and the surgeon must ever be on the watch for the approach of peritonitis, which is the great danger to be apprehended in all injuries of the abdomen; wounds of these parts are always followed by peritonitis, as part of the process of healing; but then it is local and confined to the immediate neighbourhood of the injury. But the diffuse peritonitis is more serious; accompanied by tenderness all over the abdomen, especially at the wound, tympanitis, vomiting, hiccough, hard, quick and small pulse, great heat of skin and anxious countenance. This traumatic peritonitis is attended with exudation of serum or ill-conditioned lymph, and will run its course in a very short time.

*In the treatment of peritonitis* the surgeon must be guided by the condition of the patient. If he is young, strong, and healthy, it will be necessary to remove blood from the arm or to apply numerous leeches over the abdomen, followed by warmth in the form of poultices or fomentation. Opium should be freely given, and its influence closely watched. Calomel with the opium may be administered either at short or more lengthened periods. The influence of the opium on the sufferer is a guide to continuing it or not. Or opium and mercurial inunction may be adopted; the latter being highly spoken of. The diet should be just enough to support Nature, in the form of barley water, whey, or other light drinks.

## WOUNDS OF THE SPINE.

INJURIES of the spinal cord may be divided into concussion and compression, the same as injuries of the brain, to which they bear much resemblance.

*Concussion* may occur directly or indirectly, as, for instance, from a blow, or by falling from a height on the buttock.

Mr. Alexander Shaw says, in his remarks on Concussion of the Spinal Cord: "But certain cases of injury of the back are met with in which paraplegia has directly or shortly afterwards occurred, and in which, upon examination of the spine after death, no fracture, displacement, extravasated blood, or anything capable of compressing the cord, can be discovered. The explanation therefore given is, that the spinal cord had been damaged by concussion."\*

The following symptoms are usually present from direct violence: pain at the seat of the injury, vomiting. If the phrenic nerve is irritated, hiccough, and feeling of constriction round the body will be present. When the vagus nerve is irritated, there will be a sense of suffocation, with probably irregular action of the heart and distressing vomiting. There may be loss of power over the sphincters of both bladder and anus, with incontinence or retention of urine or fæces, or the bladder only may be affected.

In concussion from indirect violence, the symptoms are sometimes insidious and protracted. The injuries may have been received elsewhere, but subsequently disease is developed in the spinal cord.

Concussion of the spinal cord is more frequently met with in civil life than in the army, but may occur with the soldier from a spent ball or fragment of shell, from the falling of planks or earth in the explosion of mines or magazines, or in assaults from men falling back into ditches, as observed by the writer.

In treating these injuries, absolute rest to the parts is the principal object to be arrived at.

Mr. Erichsen, who appears to have made a special study of this subject, says: "The importance of rest cannot be over-estimated. Without it no other treatment is of the slightest avail; he considers it is of the utmost importance to insist upon absolute and entire rest for this reason, that not unfrequently patients feel for a time benefited by movement, but nothing

\* 'System of Surgery,' by T. Holmes, M.A., vol. ii., p. 371.

can be more erroneous than this idea, for the patient will invariably be found to fall back into a worse state than had previously existed. With this rest, which should be in the prone position, he recommends chloral to procure sleep, and the bromide of potassium to allay the irritability."\*

Counter-irritation may be applied to either side of the spine, and if there are inflammatory symptoms present, ice may be used with advantage: subsequently tonics in the form of iron, strychnine, and cod-liver oil.

*Compression of the spinal cord* may be induced by injuries to the vertebræ, such as fractures, dislocation, penetration by gun-shot wounds, or by extravasation of blood or pus. The symptoms produced depend much upon the position of the injury.

These injuries are of the greatest interest to the surgeon, as much will depend, as regards the future of the sufferers, on the amount of damage inflicted.

In army practice wounds of the spine are much complicated, and it is seldom the surgeon has an opportunity of being left in any doubt as to the exact seat of injury, the wound being so self-evident.

*In dislocations or fractures without an external wound*, the symptoms which generally present themselves are shock to the nervous system, profound collapse, pain in the seat of injury, tumefaction of injured part, unevenness, or depression of projections in the process of the vertebræ, paralysis of body below the level of fracture.

*Paralysis in Injury of Spine.*—The extent of paralysis differs according to the part of spinal column injured, as, for instance, fracture or dislocation in cervico-dorsal region, all the body below seat of fracture will be paralysed, and if the injury to the cord has been above the origin of the first dorsal nerve, which joins the axillary plexus, some impairment in the motion and sensation of the upper extremities will be discovered; but the principal danger overhanging the patient is connected with his respiration.

Fracture and dislocation in the dorsal region, between the tenth and fourth vertebræ, cause complete paraplegia. The bladder and rectum will be paralysed, and bed sores are sure to be formed.

*In fractures or dislocation of the lower lumbar*, there may be no paralysis, if the injury is below the second lumbar vertebra, in consequence of its being below the level of the spinal cord, which terminates at the second lumbar.

*Injuries of the spinal column, above the origin of the phrenic nerve*, are attended with instant death.

No attempt should be made to reduce a fracture or dislocation of the spine. Means should simply be adopted to support nature by means of nourishing diet, to prevent sloughing bed sores, by placing the sufferer on a water-bed or soft mattress.

\* Erichsen's 'Science and Art of Surgery,' vol. i., p. 357.

Urine should be drawn off regularly, and great cleanliness observed.

The bowels may be moved involuntarily at first, afterwards they may be constipated, when they should be relieved by enemata.

*In penetrating wounds, where the vertebræ may be driven in on the cord, splinters, articles of clothing, and muscular tissue, may have to be elevated, extracted, or removed.* With a view to enable the surgeon to do this, the trephine, elevator, or small saw, may be had recourse to.

*The Trephine in Injuries of the Spine.*—Mr. Longmore, in speaking of the use of the trephine in these injuries, says: "In injuries of the vertebral column and spinal cord occurring in military practice, the mischief is usually so complicated and extensive, and the medulla itself so bruised, that the cases must be very rare indeed in which the operation of trephining, if justifiable in any case, can offer the slightest prospect of benefit." He mentions that M. Baudens extracted by means of an elevator a ball which had lodged in the eleventh dorsal vertebræ, and was causing compression with complete paraplegia. The paralysis disappeared immediately after the extraction of the bullet; but tetanus came on four days afterwards, and proved speedily fatal.\*

Sir C. Bell condemned trephining the spine, but the measure has its advocates.

The operation is one attended by considerable trouble and difficulty, and when completed it may be discovered that the cause of compression is out of reach, being displacement of a body of a vertebræ instead of a depression of an arch or process.

The course recommended to be adopted in applying trephine, is first to make an incision in the line of the spinous process, about an inch deep and six inches in length, or according to the extent of the injury, through the skin and muscles, which should be cleared away on either side of the spine, and bony structure exposed to admit of the trephine being applied. Before using the instrument, loose pieces of bone should be elevated and removed, care being taken not to push any spiculæ into the spinal cord.

Hey's saw and a cutting pliers will be found most useful in dividing processes or arches.

Mr. Shaw considers that, "in injuries of the spine, except in those cases of fracture high in the spine, in which respiration has been interrupted, the paralysis is not the direct cause of the fatal termination, in cases of fracture generally.

"The chief dangers to life arise from extensive and exhausting sloughs and bed sores, morbid condition of the bladder and urinary organs generally, and in a certain degree derangement of the bowels. These are indirect effects of the paralysis. But if they be overcome, the mere loss of

\* 'Longmore on Gun-shot Wounds,' Helmes's 'System of Surgery,' vol. ii., p. 183.

motion and sensation in the limbs, and inability to control the action of the bladder and rectum, will destroy life, or be inconsistent with the patient enjoying good health. The principal aim in treatment ought to be to avert those bad consequences, and endeavour to preserve life without incurring formidable risks in expectation of getting rid of the paraplegia."\*

\* 'Injuries of Back,' by Alexander Shaw; Holmes's 'System of Surgery,' vol. ii., p. 109.

## WOUNDS OF THE PELVIS.

*Classification of Wounds of the Pelvis.*—Mr. John Birkett arranges injuries of the pelvis in the following manner:—

I. Contusion involving the soft parts in contact with the outside of the pelvis.

II. Fractures and dislocations of the bones forming the pelvis.

III. Injuries of those organs in relation with the pelvis which are connected with the functions of—

A. Micturition ; B. of Generation ; C. of Defæcation.\*

Contusions of a slight form require no difference in their treatment from similar injuries in other parts of the body. At the same time, Mr. Birkett remarks: "Contusions of an apparently trifling nature, at first slight, may yet be attended with appalling results. Thus, a delicate, strumous, badly-nourished individual receives an injury of the pelvic region, the primary effects being merely a local tenderness or stiffness. But in a few days intense constitutional disturbance may arise, and death ensue from disease of the membranes of the spinal cord."†

*Contusions* may be of a severe nature, as from a spent cannon-shot or fragment of shell, producing great extravasation of blood under the integuments or gluteal fascia, giving rise to a circumscribed swelling, which may be recognised from that of an abscess by its appearing immediately after receipt of injury, whereas an abscess would be longer delayed. These swellings will, as a rule, disappear after repose and local application of stimulating lotions.

The soft parts covering the pelvis are frequently torn and lacerated by fragments of shell, splinters of wood, and other missiles. The wound should be readjusted, as far as possible, with a hope of their uniting.

*Fractures and Dislocations.*—The pelvic bones may be fractured, dislocated, crushed, or bullets, fragments of shells, &c., may be lodged in them, which injuries are attended with risk to life, not alone from the damage to the bones, but from the contents of the region being involved in the mischief. In the treatment of fractures, most perfect rest should be enforced, the bones being first replaced, if possible. Dislocations should be reduced, and to assist the surgeon in doing so, "it is recommended to introduce the index finger into the rectum, while the patient is under the influence of chloroform, when the bones may possibly be brought into their normal relations with sacrum."

\* 'Injuries of the Pelvis' (Holmes's 'System of Surgery'), by J. Birkett, vol. ii., p. 708.

† *Ibid.*, p. 715.



*Lodgment of Balls in Pelvis.*—Mr. Guthrie has removed balls on different occasions which have lodged in the pelvis, and always with the greatest advantage when done early. He has seen much evil result from their being allowed to remain, as they caused not only frequent distress, but at last gave rise to disease in the bone, derangement of the general health, and death. "When the ball can be felt impacted in the bone, incisions through muscular parts of little consequence should not be spared to expose it. If an error exists at this moment, it is that too little is done rather than too much." \*

Mr. Hamilton, of the U.S.A., remarks: "If a ball has penetrated either of the alæ, where they are thickly covered by the great gluteal muscles, it would be difficult to discover or to remove the fragments. The great depth of the muscular coverings, and the size and number of blood vessels with which they are supplied, render all surgical interference improper. But in case the perforation occurs near the upper margin of the pelvic bones, there can be no impropriety in instituting a search for any foreign substance which may be supposed to have lodged within. If the edge of the crest only is broken off, the finger can be easily carried along the track of the wound to a certain extent, and the probe may be introduced pretty freely without much danger of its doing harm. Indeed, it is our opinion that, in case the perforation was very near the crest of the ilium, constituting only a smooth, round hole, through which the loose fragments could be distinctly felt, but was insufficient for their extraction, it would be proper to apply the trephine, so as to enlarge the opening. Certainly there is no more important indication than to remove the fragments, and we do not see why the surgeon, under these circumstances, need hesitate to perform so trivial and safe an operation at once. For this purpose a large trephine should be employed, and in order to avoid the necessity of dissecting up the muscles extensively for the purpose of finding a sound piece of bone upon which to rest the pin of his trephine, he might adopt the excellent suggestion of Mr. Guthrie in certain cases of fracture of the skull—namely, to support the crown of the instrument in a circular opening made in a bar of iron, the two ends of the bar being held and steadied by assistants; or perhaps it would answer equally well to employ for this purpose a piece of wood, the opening in which may have been previously made by the trephine itself." †

*Injuries of the organ of micturition* may be caused without fracture of the pelvis by the wheel of a gun-carriage passing over, by a fall, or by a heavy weight. With fracture of the pelvis, by splinters of bone, by bullets, or other missiles, bayonet, lance, or sword thrusts, a large vessel may be wounded, which will prove rapidly fatal from hæmorrhage.

\* Guthrie's 'Commentaries,' p. 600.

† 'Military Surgery and Hygiene,' by F. H. Hamilton, M.D., p. 339.

Should the bladder be wounded, the sufferer may be so fortunate as not to be hit in a place where immediate extravasation of urine takes place, and consequently he may survive the wound, but will be subject to great suffering from the inflammatory symptoms consequent on the injury, producing irritability of bladder and tenesmus; "the first measures, therefore, to be adopted are to introduce a large catheter and fix it in the bladder, so as to admit of the urine passing through it as soon as formed, and prevent irritation by lodgment. Some patients will not tolerate its being fixed in the bladder; it must then be introduced frequently."

In the event of the bladder being injured so as to admit of extravasation into the pelvic cavity, or peritoneal cavity, the case will probably terminate fatally, from the amount of irritation and inflammatory action, or the shock on the system.

During the Indian Mutiny a case of wound of the bladder came under my notice. The infliction of the wound with a bullet was immediately followed by a collapse, cold clammy skin, pallid countenance, vomiting, and frequent desire to pass water, which was bloody. The unfortunate sufferer never rallied, and died in a few hours.

I have already mentioned that in these injuries an attempt should be made to prevent further extravasation by the introduction of an elastic catheter; but as it is generally a considerable time before wounded come under the care of the surgeon, the mischief from extravasation will have taken place; but this is not to prevent an attempt being made. In cases where the back part of the urethra or neck of bladder has been injured, so as to prevent the introduction of a catheter, an opening should be made in the perineum to admit of the discharge of urine.

Should there be signs of external extravasation free incisions must be made in perineum, or such positions as will readily admit of its escape, and that of decomposed cellular tissue.

*The early constitutional treatment in all wounds of the bladder* should be with a view to preventing or subduing the inflammation which must inevitably set in. Local or constitutional bleeding may be necessary. Drinks should be in small quantities. The diet should be very sparing at first.

The bowels will require evacuation by means of oil enemata, but opium must form the great means of affording relief, and it should be administered by the mouth, or in the form of a suppository, or as an enema.

*Bullets have lodged in the bladder*, when they have become encrusted with urinary deposits, and after a time require removal by the operation of lithotomy.

In wounds of the abdomen, with *protrusion of bladder*, it has been already stated that a gum elastic catheter should be introduced, with a view to assisting in its reduction.

## WOUNDS OF PERINEUM AND GENITAL AND URINARY ORGANS.

THESE wounds are rare in war, the parts being more or less protected. During the Crimean War and Indian Mutiny, the writer only saw one example of this description of wound, which occurred to a soldier who, while attending to the calls of nature in an advanced trench, and in the squatting position, was struck with a fragment of a shell, which removed the scrotum as if it had been done by a knife, lacerated the buttocks and divided the sphincter ani, causing violent hæmorrhage and involuntary passing of stools. The misery and intense suffering of this patient can scarcely be described, and as the healing process was entirely by granulation he was a long time under treatment.

*Wounds of Penis and Urethra.*—Missiles have been known to traverse the perineum, penis, and otherwise injure these parts. In wounds where the urethra has been laid bare, a catheter should be introduced and tied in, and if the wound be clean with edges in such condition that adhesion might be anticipated, they should be brought together by interrupted sutures, but if much lacerated it will be necessary to wait patiently the process of healing by granulation, taking care that the urethra is kept free by introduction of a catheter whenever the patient requires to pass water. When the laceration has been so extensive that closing by granulation is impossible, it is best to try and retain the direction of the urethra as far as practicable by frequently introducing a sound or catheter, and afterwards close it with a plastic operation.

*Wounds of the scrotum or spermatic cord* require but little interference. Open wounds should be closed by sutures, and the parts dressed with cold water, and well supported.

It may be laid down as a general rule that all incised or lacerated wounds of the genitals should be closed by sutures, if the parts can be possibly brought together. The integuments are very loose, and, if not properly secured, form large gaping wounds, which take a long time to heal.

*The testicles may be severely bruised, shattered, or detached from the cord.* The condition is most painful, and requires the administration of opium to secure relief. The organ should be well supported, and cold or warm water applied. Should there be any portion of either testicle partially detached it may be removed, as in all probability it will become diseased.

*Wounds of the anus and rectum* heal readily, but from their close proximity to the bladder and peritoneum inflammatory symptoms must be looked for, and checked.

## WOUNDS OF THE EXTREMITIES.

*Classification of Wounds of the Extremities.*—These wounds may be divided into contusions, lacerations, incisions, or punctures of soft parts, injuries of bones or joints, all of which may be complicated with wounds of the great arteries or nerves.

With regard to contusions, lacerations, incisions, or punctures, their treatment has already been remarked upon; it is therefore unnecessary to refer to these again. Injuries of bones and joints will now be considered, and in connection with them wounds of arteries and nerves.

*General Remarks on Gun-shot Fractures.*—"Bones may be injured by having the periosteum contused or removed, as when a bullet is flattened against them, giving rise to periostitis, exfoliation, or throwing off of scales, and frequently to disease of the medulla, or formation of deep abscesses, producing great constitutional disturbance."

Bones may be fractured, which injuries, as in civil life, are divided into simple, compound, and comminuted; but in consequence of the instruments or weapons which inflict them in war, they, as a rule, present peculiarities to the army surgeon not met with in civil life, where accidents to bones generally arise from falls, kicks, or muscular action, whereas in the army fractures are for the most part caused by direct violence, by spent cannon-shot, bullets, slugs, grape-shot, fragments of shell, and other missiles, causing many complications.

Simple fractures are probably the most rare of all met with on active service; but should such occur on the field, the surgeon will have much to consider, as from any want of care, or from improper adjustment of splints, the broken ends of the bones may protrude through the soft parts, forming a compound fracture, or by the rubbing together of the ends of the bones extensive inflammation may be set up, followed by suppuration and prolonged disease, or should the appliance be too tight, gangrene of the limb may follow.

There may be great contusion of the soft parts, which will interfere with the adjustment of the splints, and add to the difficulties in transport. Numerous plans have been invented and proposed for the transport of fractured limbs, such as plaster of Paris bandages, wire-trough splints of the French, and various splints made from materials which may be found at the time of the injury, as already described under the head of extemporary appliances.

Compound fractures are usually produced by the direct contact of a

bullet or other missile with the bone, and consequently inflicting most serious injury to the bone itself and surrounding parts, but not necessarily producing a comminuted fracture, as might be expected.

Professor Longmore describes partial fractures, which he says "can scarcely be produced by any other agents besides projectiles, and which are rare accidents in civil practice. They are: 1. Removal of portion of a bone by the projectile making a furrow in its passage across its surface—grooving it; 2. Removal, splintering off, of longitudinal fragments from the external cylindrical part of a bone; 3. Removal of a part of the bone by completely punching out a portion, thus leaving a hole through the entire substance of the bone; and 4. Partial fracture, by driving inwards part of the external cylinder, and causing the fragment to lodge in the cancellated structure. This latter partial fracture is generally attended with lodgment of the projectile also. Among the complete fractures, those attended with general comminution, in the neighbourhood of the part of the bone struck, with dispersion of the fragments among the surrounding soft tissues, and those which may be spoken of as 'resecting fractures,' can hardly be caused accidentally, except by fire-arm projectiles.\*"

From Mr. Longmore's observations, it will be seen that in warfare fractures of bones, as caused by weapons of war, are rarely confined to the ordinary, transverse, oblique, or longitudinal, but are a combination of the whole, or those peculiar to gun-shot wounds.

*Simple and Compound Fractures on the Field.*—In arranging for fractures on the field many difficulties have to be contended with: first, the transporting of patient from field to fixed hospital, then securing proper beds, ventilation, and nursing. If an attempt is made to save a limb extensively fractured, and with an external wound, the suppuration which usually follows is so profuse that much difficulty will be experienced in keeping the limb clean and dry, the bandages and splints being constantly soaked with discharge, rendering the air offensive and injurious to health, or inducing pyæmia, which injuries of the bones appear to specially favour in bringing about, also osteo-myelitis and suppuration of the medulla.

With regard to the dressing of compound fractures on the field, Mr. Hennen remarks: "It is questionable if compound fractures could be set at the time of infliction, and the proper apparatus for continued extension applied." In many situations, he says, this is utterly impracticable from the nature of the service. Immediate extension and coaptation are not applicable in all cases, neither are they absolutely necessary to the present comfort and future safety of the patient. In no instance during his experience did the most skilfully dressed limb on the field preclude the necessity of going over all the steps of resetting, and consequently of redoubling the patient's anguish.

\* 'Longmore on Gun-shot Wounds; Holmes's 'System of Surgery,' vol. ii., p. 214.

Mechanical appliances are now so perfected that, with the exception of a fractured femur, there is no lesion of the bones of the extremities that surgeons need have the slightest hesitation in transporting for considerable distances, prior to inflammatory symptoms setting in, care being observed as to the adaptation and application of splints.

Dr. Stromeyer remarks on this important subject: "Above all things it appears to me to be necessary that cases of gun-shot fracture of the thigh should not be transported to a distance, but should be carried on a stretcher to the nearest house, and the treatment carried out there, even at the risk that the wounded should fall into captivity."

*Gun-shot fractures of the upper extremities* are less dangerous than in the lower, circumstances being as nearly as possible alike.

Since conservative surgery has been so much practised, it is seldom necessary to remove an upper extremity for injury to the bones as a primary operation. Rare cases, however, require it, as, for instance, when the humerus is broken and splintered into the shoulder joint, the muscles, great vessels, and nerves injured without prospect of their recovering themselves, as in an injury that would occur from a spent cannon-shot or shell striking the arm.

Guthrie remarks: "An upper extremity should not be amputated for almost any accident which can happen to it from musket-shot; and there is scarcely an injury of the soft parts likely to occur which would authorize amputation as a primary operation."\*

A case is related of a soldier in India receiving a sword cut, which divided his arm, bone and all, with the exception of the vessels and nerves, and the muscles on the inner side, yet he recovered, the bone of the arm uniting.†

When the shaft of the humerus is much splintered, detached pieces should be removed, fragments of clothing or foreign bodies extracted, points of sharp splinters should be cut off and the arm placed on a convenient splint, pillow, or cushion, giving it perfect support and rest. For this purpose Dr. Stromeyer has designed a cushion, the utility of which he was so good as to demonstrate to me at Versailles, during the late Franco-German War. An illustration can scarcely do credit to this admirable contrivance, which affords perfect security and comfort to the injured limb, and with which every army hospital should be supplied.

"The cushion may be described as a right-angled isosceles triangle, four inches thick at the apex, which rests against the chest and supports the elbow, the forearm being bent at a right angle with the arm. The cushion gradually thins down till the base is a mere edge, and of the two other angles, one is passed up into the axilla, while the other rests on the chest

\* Guthrie's 'Commentaries,' p. 111.

† Macleod's 'Notes on the Surgery of the Crimean War,' p. 304.



under the wrist, as represented in fig. 62. The cushion is readily fastened in its place by a tape round the neck, and one round the body, as seen in fig. 63. When this simple apparatus is applied, the arm rests upon it, beautifully supported, and in excellent position. Whilst lying in bed, nothing beyond the ordinary dressings are required for the wound, and if the patient needs to be transported from one place to another, or is fit to walk about, this can be arranged for with the utmost facility, as cushion, arm, and all can be bound by a broad bandage to the body, and thus form an immovable whole."\* Stromeier informed Dr. MacCormac that so highly did he estimate the value of this cushion, that he considered it the

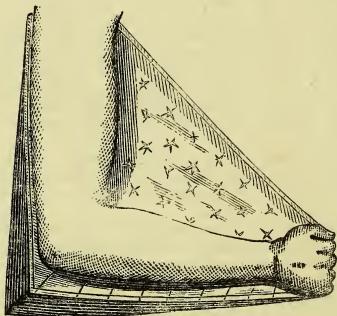


Fig. 62.

most valuable appliance he had invented during his life. Dr. MacCormac has tried the mode of treatment and found it answer every purpose, and recommends a good-sized one, of which the sides measure about fourteen or fifteen inches in length. I have used this appliance myself, and cannot speak too highly of it, but it requires different measures for different persons.

Mr. Guthrie recommends that when the splinters extend far into the shaft of the humerus, it may be proper to amputate the whole extremity, especially if the great artery and nerves be wounded; if, however, the head is not injured, the amputation should take place immediately below the

\* 'Notes and Recollections of an Ambulance Surgeon,' by W. MacCormac, p. 96.



tuberosity, and not at the joint, so as to retain the round appearance of the shoulder. Hamilton, of the United States Army, in the treatment of gunshot injuries of the humerus, usually employs a single splint made of felt, leather, or gutta percha, long enough to extend over the top of the shoulder on the one hand, and to the lower part of the elbow on the other, and broad enough to encircle one-third of the circumference of the arm. By moulding, or otherwise fitting the upper part of the splint over the top

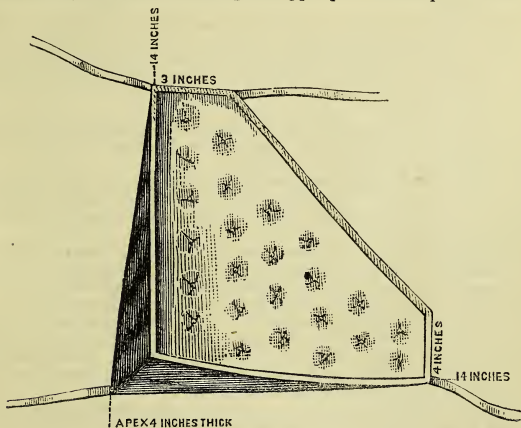


Fig. 63.

of the shoulder, it will be prevented from becoming displaced downwards. He considers that bandages have, as a rule, been applied too tightly.

*Injury of the head of humerus:* (*vide* "Injury of Joints.")

The radius or ulna may receive extensive injuries from bullets or fragments of shells, the rule of treatment for such injuries being to remove fragments of bones or splinters, and place the arm on a suitable splint with a view to union taking place; at the same time passive motion should be adopted early to prevent the bones uniting with one another, thereby rendering pronation and supination imperfect. When both bones are extensively

broken, the soft parts lacerated, and vessels and nerves damaged, which often occurs from a bullet passing through both bones across the arm, amputation should be performed, but every endeavour should be made to save a forearm which is well supplied with blood; mortification is consequently not likely to take place.

In the event of amputation being necessary, the surgeon should be careful to leave as long a stump as possible, to which a mechanical contrivance can be attached.

Hamilton suggests that in case both bones are broken, the patient ought to be kept in the recumbent position on the back, with the forearm resting upon a pillow supported by a board, extended and supinated. No attempt should be made to lengthen the limb by apparatus, but daily attention should be given to the position of the bones, and as far as possible they should be kept in line.\*

*In wounds of the hand*, as little as possible of the injured parts should be removed, and, above all, the value of the thumb or a finger should be carefully considered in any operative measures.

In extensive wounds from cannon-shot, or fragments of shell, amputation of the hand may be necessary; but wounds from bullets generally damage one or two metacarpal bones, or may pass between two, only injuring the soft parts.

*Wounds of the Metacarpal Bones.*—When the metacarpal bones are injured, that is, splintered, the wound should be enlarged and fragments removed, taking care that the tendons are not injured or interfered with if untouched by the missile. Generally speaking, the extensor and flexor tendons are injured, the result being stiffness of the fingers to which they belong. Guthrie recommends that, when one or more fingers are destroyed, and the metacarpal bones injured, they are to be sawn or cut off, but not removed at the carpus, although an opening into the joint of the carpus will generally do well, if skin can be saved to cover it.

In all cases of amputation of one or more fingers, the metacarpal bones, if injured, should be left as long as possible, and particularly that of the index fingers when the thumb remains.

*Wounds of the Phalanges.*—The phalanges may be broken, when, if in a single finger, a splint composed of wood, gutta percha, or other suitable material, should be placed on the palmar surface of the entire length of the finger, a piece of lint, cotton wool, or other soft texture being first laid against the skin.

If several fingers are broken, the splint should cover the whole palmar surface, the wrist joint being left free.

*Injury to the Hand and Wrist.*—The hand, wrist, and forearm are liable

\* Hamilton's 'Military Surgery,' p. 394,

to sword-cuts, which frequently injure the bones or joints. It is seldom necessary to do more than close the wounds, and support the parts by suitable splints.

*Gun-shot fractures of the lower extremities* are far more dangerous and serious than those of the upper; and as to fracture of the femur, either simple or compound, it will, on active service in the field, cause the surgeon grave anxiety, and perplex him as to the best measures he can adopt, for opinions vary much on this subject.

*Simple fractures of the shaft* may be put up in the semi-flexed position of Pott, the straight of Desault and Liston, or the double-inclined plane, or by any of the numerous modifications of either.

An important question for the consideration of the army surgeon is, What is best to be done for gun-shot fracture of the thigh with an army on the move, as transporting a sufferer with such an injury is a very serious matter? Stromeyer is of opinion it is best to leave the sufferer in captivity. Esmarch is, doubtless, of the same opinion, as, during the Holstein War, he entrusted such wounded to the enemy, rather than allow them to suffer from transport. There are, unfortunately, occasions where it is not possible to carry out this excellent advice of Dr. Stromeyer, which, in European warfare, and under the privileges of the Geneva Convention, should be adhered to. But supposing the contest is with savage tribes, as has lately occurred with the British forces in Western Africa, that the distance is considerable to a permanent hospital, that the roads are bad, and transport indifferent, what, then, should be the course of action?

For a fracture where the bones are simply broken, not splintered, an attempt might be made to save the limb by placing it in the straight position, with a long splint, as recommended by Mr. Samuel Cooper, who, in his remarks on Desault's long splint, and referring to his experiences of compound fracture of the thigh during the campaign in Holland in 1814, says: "The superiority of long splints, extending the whole length of the limb, was in these cases particularly manifest. With such splints, which maintain steady the fracture itself, the knee, leg, ankle, and foot, the patient may, in fact, even be moved upon an emergency from one place to another without any considerable disturbance of the broken part." \* Since Mr. Cooper wrote the above remarks, plaster of Paris bandages and other appliances have been introduced into military practice, which may prove better expedients.

But a patient suffering from a severe gun-shot fracture of the middle or lower third of the thigh could scarcely be carried a considerable distance over bad roads (such as occurred in Western Africa) without further endangering his life. I am, therefore, of opinion that the chances of pre-

\* Cooper's 'Surgical Dictionary'; Article on Fractures.

serving life would be increased by immediate amputation, there being no doubt that, to secure success for conservative treatment, the sufferer must not have undergone lengthened transport, fatigue, or privation.

An amputation of the thigh having been performed, the stump can be easily secured for transport.

In gun-shot fractures of the upper third of the thigh under the foregoing circumstances, the surgeon should try and conserve the limb (amputation generally proving fatal), by securing it for transport with a long splint extending from axilla to beyond the foot, and fastening both legs together. Loose splinters of bone should be removed.

The unfortunate sufferer's prospects will, in either case, be very bad, as patients seldom survive such injuries.

Compound fractures of the femur from gun-shot wounds are attended by extreme danger; the violence that has caused a fracture of such a bone must be very great, the shock to the system considerable, and the prospect of treating such an injury by conservative measures most unfavourable.

Hennen was convinced, after great experience, that the sum of human misery will be most materially lessened by permitting no ambiguous cases to be subjected to the trial of preserving the limb—constitution, convenience for treatment, and local circumstances having their full weight in the decision.

Guthrie, referring to the result of treatment of forty-three selected fractures of the thigh, which were attempted to be saved under his own direction at the battle of Toulouse, reports that of this number thirteen died; twelve were amputated at the secondary period, of whom seven died; and eighteen retained their limbs. But he considers the result most unsatisfactory, notwithstanding the care and attention bestowed upon them.

"Nearly all the wounded, after this battle, had every possible assistance and comfort from the second day after the action. The hospitals were well supplied with bedsteads—no inconsiderable point in the treatment of fractures. Every broken thigh or leg was in the straight position, and the success was greater than on any previous occasion. Nevertheless, with all these advantages, there can be little doubt that, if amputation had been performed in the first instance on the thirty-six out of forty-three who died or partially recovered, some twenty would have survived, able, for the most part, to support themselves with a moderate pension, instead of there being perhaps five, or at most ten, nearly unable to do anything for themselves." The least dangerous and most likely to be saved, he considers, are fractures of the lower third, or at most of the lower half, of the thigh bone; and when they do not communicate with the knee-joint an attempt ought always to be made to save the limb.

Mr. Alcock remarks on this subject: "I do not agree with Mr. Guthrie;" and though he admits his experience is more limited, still he is of opinion

that the expediency on service of ever delaying the removal of the limb with a complete fracture of the femur lower third from gun-shot wound appears to him doubtful. This only refers to soldiers; with officers the results are less unfavourable.

During the Crimean War the treatment of this injury afforded a subject of great interest. Mr. Longmore informs us that the results of the practice by conservative measures, being the means of preventing amputation, were not realised. Of the three modes of treatment, resection was the most fatal, conservative treatment next, and amputation least fatal. The first was uniformly fatal; the deaths among cases treated without operation were 82 per cent.; the deaths among those treated by amputation, almost hopeless cases included, were 65·2 per cent.

In considering the results of gun-shot fractures of the femur, the situation of the injury is a matter of great importance as regards the chances of recovery, whether without or with amputation.

In the official history of the Crimean campaign this fact is shown in the results of amputation, the recoveries in the upper third being 12·9, in the middle third 40, in the lower third 43·3 per cent. of the cases treated; but the distinction is not made in regard to the recoveries without amputation.\*

Stromeyer, who has had great experience, has favoured us with the following opinion:—"I differed from Guthrie in one essential point—that of his preferring amputation for gun-shot fractures of the thigh to conservative treatment. Guthrie puts too much stress upon the imperfections of conservative treatment, the result of which is often a very disabled limb, whose possession does not make the patient very comfortable. But these imperfections admit of improvement, while a high amputation gives no prospect of better chances; it will always remain a very dangerous operation. Our first object is to save a man's life, and the second to make him comfortable, but not in his grave. My results of conservative treatment in gun-shot fractured thigh during the first three campaigns of 1849, 1850, and 1866, did not go beyond 50 per cent. healed. I saw the reasons of our failures, tried to avoid them, and went on with conservative treatment. In the two campaigns of the Schleswig-Holstein (1849 and 1850), the patients had to be carried to considerable distances. After the battle of Lanzensolza, in 1866, I was unable to prevent many cases from being spoiled by an injudicious use of plaster bandage. It was in Floing, near Sedan, where we succeeded in saving 77 per cent., twenty-seven amongst thirty-five patients, who had been carried to no great distance, and were treated without putting much restraint on their shattered limbs.

"According to my opinion, the great principles to be followed in com-

\* Holmes's 'System of Surgery,' vol. ii., p. 224.

pound fractures in general are :—(1) Dressing the wounds without lifting the limb ; (2) avoiding constriction ; and (3) not irritating the muscles in straining them by mechanical contrivances. A gun-shot fractured thigh permits a weight to be suspended to it, keeping the limb a little at rest, like the hand of an assistant, but not an extension by weight or other contrivance, which gives the limb its proper length, except in very few cases.

“ The most common case is, that for some time after the accident the muscles retain a tendency to retract, which is increased by opposition, and ceases by-and-by in a favourable position of the broken limb.

“ The idea of subduing muscular action by constant extension, even in compound fractures, is not new ; but it had not been tried before by contrivances so dangerous as a plaster of Paris bandage. This is applied under chloroform, which relaxes the muscles ; the limb is made straight and as long as its fellow. When the action of chloroform has ceased, the muscles recover their activity, and are kept in extension in spite of their violent efforts to contract, which often break the plaster bandage. The tension, which is kept up by mechanical means, makes the sensibility rise to a high pitch, and severe inflammation follows. If the plaster bandage be loosely applied, by putting wadding and a flannel roller between, it is often well borne, but the limb is as short afterwards as if no bandage had been employed.”\*

It appears remarkable that such eminent authorities as Stromeyer and Guthrie should differ on this point ; but the fact is, that Guthrie formed his opinion from experiences in Peninsular and Crimean campaigns, where fractures of the femur were treated under totally different circumstances to Stromeyer's experiences, who in all probability was enabled to secure proper accommodation, food, and attendance for his wounded ; whereas, during the Peninsular and Crimean wars every discomfort and inconvenience that man could be subjected to were present with the British army, which unfortunate circumstance gave conservative treatment the disadvantage.

Pirogoff, in 1849, after great mortality from thigh amputation for gun-shot fractures, was induced to try conservative treatment in ten cases of bad compound fracture of the thigh, which had done well not only without operation, but without treatment of any kind. He was also of opinion that the application of a permanent paste bandage would render the transport of such wounded possible. During the Crimean War he experienced 90 to 95 per cent. death-rate in primary thigh amputations, as did the French ; but in the German hospitals, during the war of 1870-1871, more than thirty cases of recovery from gun-shot fractures of the upper and middle thigh

\* Address delivered at St. Thomas's Hospital, London, May 23rd, 1872. *Lancet*, 25th May, 1872, p. 722.



were met with ; whereas, of thigh amputation only twenty-one survivors were found, and in none of these had the operation been performed in the upper third.

Many military surgeons of the present day appear to consider conservative treatment for gun-shot fracture of the thigh the proper course to be adopted ; but there are circumstances where it may not be desirable, as want of proper accommodation, attendance, appliances, exposure to extremes of climate, necessity for moving, under which conditions amputation would most certainly give the sufferer the best chance of recovery.

During the early part of the siege of Sevastopol, when wounded were subjected to every discomfort that can possibly be imagined, and when the best bed was a bundle of brushwood, without blankets, in a bell tent on a mud floor, the prospects of treating a compound fracture of the femur conservatively were most unfavourable, and that of amputation little better ; but of the two, amputation in the middle or lower third gave the sufferer the best chance. Again, take exposure in a tropical climate, with intense heat, indifferent accommodation, and want of competent nursing, amputation would no doubt be attended with more favourable results. It is, therefore, only under certain conditions, such as good accommodation, food, ventilation, and attendance, with suitable appliances, that conservative treatment should be attempted.

Mr. Macleod, who closely observed these injuries in the Crimea, remarks : " It can hardly be doubted that the great straining after conservatism which influenced all the surgeons of the army was one main cause of that mortality which attended these injuries." Again he says that, " under circumstances of war similar to those which occurred in the East we ought to try and save compound comminuted fractures of the thigh when situated in the upper third, but that immediate amputation should be had recourse to in cases of like accident occurring in the middle or lower third."\*

Erichsen considers amputation especially necessary in some of the more serious injuries of the lower extremities. Thus, if a bullet divide the femoral vessels or the sciatic nerve, splinter the thigh bone, or if the sciatic nerve and soft parts at the back of the thigh be carried away, although the vessels and bone be left uninjured, the case is one for amputation ; and, indeed, it may be stated generally (though doubtless there are exceptions to this, as to all general rules in surgery) that all compound fractures of the lower third of the femur occasioned by gun-shot require amputation.

Hamilton, of the U. S. Army, in his remarks on gun-shot fractures of the thigh, says : " We have not in our possession full statistics of the present war, but sufficient facts have come to our knowledge to indicate that there

\* Macleod's 'Notes on the Surgery of the War in the Crimea,' p. 278.



has been, on the part of our surgeons, a large amount of conservatism, especially in reference to the treatment of gun-shot injuries of the thigh. Our own impression is, that in those injuries conservatism has ruled too much, and that amputations have been too little practised." He lays down certain rules to guide the surgeon as to when he ought not to attempt to save the thigh after a gun-shot fracture, which are as follows:—

When a patient has to be carried far over rough roads and without adequate support to the limbs.

When the bones are greatly comminuted.

When the patient suffers great pain, or violent spasms continue in spite of opiates and rest.

When the soft parts have suffered great contusion, as in case of a fracture from solid shot or shell.

When there is very extensive laceration of the soft parts.

When the principal arteries or nerves are involved in the injuries.

When the fracture implicates the knee-joint, or even when it is near the knee-joint.

Under the following circumstances we would not, as a rule, resort to amputation:—

When the ball has entered the head, neck, or trochanteric portion of the femur. If any surgical operation is demanded in these cases, it is usually ex-section.

When the fracture is just below the trochanters; experience having shown that very few recover after these amputations.

When the fracture of the femur is caused by a pistol-ball, by a round musket-ball, or by any missile whose force is nearly spent.

It will be understood that the last observation has reference solely to the less degree of comminution which these missiles usually occasion.

The following conditions must be added as essential to success:—

All pieces of bone which are only slightly attached to the soft parts must be removed.

All foreign bodies, such as fragments of balls or other missiles, pieces of cloth, wadding, &c., must be carefully taken away. Whatever binds or obstructs the external opening, and prevents the free escape of blood or of pus, must be divided or removed.

The limb must be placed in a position of absolute rest, and must remain at rest. It must not be confined by tight bandages, or forcibly extended by apparatus.

If the knee-joint be implicated, it must be laid freely open and placed at perfect rest, without adhesive straps, bandages, or other means of compression.

During the whole treatment the limb must be handled with great care, and not lifted roughly or carelessly. When sinuses form, the matter must

be let out by direct or counter-openings, and not by violent pushing and thumbing.

When spiculæ of bone present themselves they must be removed.

The patient must be supplied with good nourishing diet.\*

*Extension in Treatment of Gun-shot Fractures of Thigh.*—In treating gun-shot fractures of the thigh by conservatism, most competent authorities agree that it is best to keep up extension to a moderate degree, but in the event of a portion of the bone being removed there will be a space between the broken ends; if, therefore, strong extension is made, the ends of the bone will be drawn asunder, and continued irritation of the muscles and surrounding tissues will be kept up.

To prevent shortening is almost an impossibility; it will, therefore, be best to allow the ends of the bone to approximate, which the muscles will do of themselves, and all that can be done is to keep the limb straight if possible. The less interference the better.

Stromeyer observes: "Do not be too anxious to remove all the fragments of fractured and displaced bones. Do not be too eager to maintain extension of the fractured limb, and abstain from frequently lifting the fractured limb for the purpose of cleanliness."

*Classification of Sequestra.*—Dupuytren has divided them into three classes, viz., Primary, Secondary, and Tertiary. The primary are those wholly separated; the secondary those partially adherent, probably by a slight piece of tissue; and the tertiary those which become necrosed. There are generally longitudinal sections into which the bone is split, and are, as a rule, capable of consolidation. The wholly separated should be at once removed, as, if not, they soon set up irritation, abscesses, pyæmia, and the usual terrible results.

Some doubts have existed as to the advisability of removing those under the class secondary, or those partially adherent, from the supposed possibility of consolidation taking place; but it is now generally admitted that in doubtful cases, or in those where the adherence of the sequestra is but slight, it is best to remove it; the chances are so much in favour of its becoming wholly detached, acting as a foreign body, with its painful consequences, that the disadvantages of such a contingent are in no way counterbalanced by the fortunate circumstance of consolidation, which is remote. Guthrie, Roux, Baudens, Legouest and Begin, are in favour of their removal.

*Removal of Sequestra.*—Dupuytren recommends that in searching for sequestra the wound should be so enlarged as to enable the fingers to pass freely and meet without impediment. Guthrie considers that "the preservation of a femur fractured by a musket-ball, when splintered to any extent, ought only to be attempted if the principal splinters can be removed. When

\* Hamilton's 'Military Surgery,' pp. 396, 399, 400, 401.

the splinters of the femur are long and large, it has been supposed that if they retain their attachment to the soft parts, they may be placed in apposition and preserved. This may be doubted.\*

The condition of a fractured femur from a rifle-bullet is always a matter of great obscurity, and it is therefore impossible to decide what steps should be adopted without making a most careful examination with a view to ascertaining the extent of injury. Long and deep incisions will have to be made, and the extent and number of them will depend upon the size and number of the splinters. It has been recommended that the wound of exit is the proper place to look for sequestra, as the ball, in passing through or traversing a limb, naturally carries them with it.

The depth of splinters in muscles is not to prevent incisions being made, nor should their proximity to large vessels or nerves interfere with a diligent search after them. It is of the most vital importance that they as well as articles of clothing, the bullet itself, or other foreign bodies should be removed, and with the least possible delay.

The limb will soon swell, become very painful, and the further the operation is postponed the more painful to the unfortunate patient, the more difficult to the surgeon, and the prospect of saving the limb more unfavourable.

Much care will be required in removing small fragments in the after-treatment, and giving free vent to pus both in the neighbourhood of the wound and along the axis of the bone when abscesses form in connection with unobserved splinters.

The patient should have tonics, good nourishment, wine, beer, porter or brandy in moderation.

Numerous contrivances and apparatus have been invented for the more convenient treatment of gun-shot fractures of the thigh; in fact, any one who has ever had to treat such an injury on service can bear testimony to the difficulties and dangers to be encountered.

Guthrie considers that "the successful treatment of a gun-shot fracture of the thigh cannot be effected whilst the patient is lying on a little straw, or a mat on the ground, and proper bedsteads should always form a part of the hospital stores of an army in the field.† The position of the patient in a gun-shot fracture of the thigh or leg is of the utmost importance. He should lie on his back, and the limb should be straight. It is almost impossible to keep a man's thigh in the bent position, or on its side, without his turning on his back, and the union of the bone, if it take place at all, must then be at an angle. The bent position forward or on an inclined plane is defective, inasmuch as the matter, which must necessarily be secreted in great quantity, will gravitate backward in spite of every care to prevent it."‡

Mr. Hamilton refers to Surgeon Hodgen's report of the Volunteers, in

\* Guthrie's 'Commentaries,' p. 146.

† Ibid., p. 148.

‡ Ibid., p. 149.

which he says "that he has not made one amputation for gun-shot fractures of the thigh, and that he has seldom interfered with the loose fragments of bone—never unless the period was favourable and they were already nearly detached. He had under his care at St. Louis seventy-one cases of gun-shot fractures of the femur; of this number fifty-two have recovered, and nineteen have died; showing a mortality of only a little over twenty-six per cent. These cases were, however, not fresh from the field, but were received after a lapse of one or two weeks from the period of the receipt of the injury."

Hamilton does "not recommend the long straight splint, with the usual means of extension and counter-extension, in any of its various forms, unless in rare cases. A perineal band can rarely be borne in gun-shot fractures of the thigh, and a long broad side splint is always very much in the way of dressings." The method he recommends is, "laying the limb upon the mattress or some sufficiently firm and even support, or on the same or nearly the same plane with the body, making the extension by a weight attached to a cord drawn over a pulley, while the counter-extension is made with the weight of the body, by elevating the foot of the bed. This is the plan, more or less modified, which has been adopted in a large proportion of the cases which we have seen under treatment; and, we think, with the best results.

"With the straight position, the limb may rest directly upon the bed, when it is not always accessible for the purpose of dressing the wounds. The limb may be moderately lifted or suspended by a frame and cotton bands.

"When extension is applied, it should be moderate and barely sufficient to steady the limb, or to prevent the ends of the broken bones from pressing into the flesh. For this purpose we apply a broad band of adhesive plaster along each side of the leg, from the knee downwards, and secure these in place with a roller, covering certain portions of the limb with cotton batting before applying the roller, to prevent excoriation. The end of the adhesive plaster should be laid over a small block below the sole of the foot, which block must be of sufficient width to protect the malleoli from the pressure of the bands. A small rope, knotted at one end, is then to be run through a hole in the centre of the block, and carried over a pulley at the foot of the bed. The pulley must be so high that the extension shall lift the heel a very little from the bed."

Mr. J. T. Hodgen has invented an apparatus by means of which the limb is maintained in a straight position, while at the same time it is lifted from the bed and rendered more accessible (fig. 64). "The apparatus is composed of four nearly parallel bars and a foot-board; two of the bars constituting the base, and the remaining two, covered by transverse slips of cloth, being intended to receive and support the limb.

"The longitudinal bars are forty-two inches long, and the upper bars are elevated four inches and a half above the lower; the space between them diminishes from the upper to the lower ends, being twelve inches at the groin, eight at the knee, and four at the foot. The foot-board is fourteen inches high, four and a half inches wide, and is supported by a cross-piece or foot underneath, fifteen inches long.

"The transverse strips of cloth, each two and a half inches wide, are placed in contact, and adapted to the inequalities of the limb.

"Adhesive straps are secured to the sides of the leg by a roller and

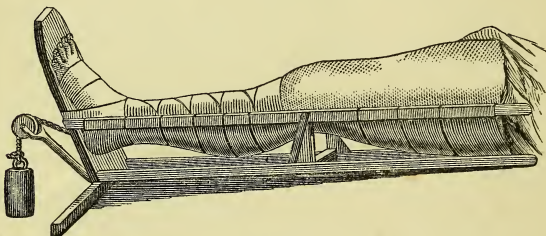


Fig. 64.

brought around the foot-piece; a cord, to which is suspended a weight, is made fast to the centre of the foot-piece and passed over a pulley, and this constitutes the extension. The counter-extension is made by lifting the foot of the bed four or six inches.\*

Mr. Hodgen has also invented a splint whereby the limb can be suspended, which it appears he has substituted for his own "cradle." "It is made of iron wire (size No. 2), and resembles in many points Dr. Smith's anterior splint, but its mode of application is not the same. Strips of cloth are laid across the splint from side to side, and upon these the limb is laid. The centre and upper extremity of the splint are kept asunder by strong bows of iron wire, so arranged that they can be put on or taken off without disturbing the dressings. When applied, the inside wire must be bent upwards at its upper extremity, so as to make room for the pubes. Extension is made by adhesive plaster, and the whole apparatus is finally suspended to the ceiling, or to some point above, by a rope and pulley" (fig. 65).\*

\* Hamilton's 'Surgery,' p. 408.

† Ibid., p. 412.

Dr. Nathan R. Smith, of Baltimore, has introduced a splint for fracture of the thigh, which no doubt will answer for simple or compound injuries. It is a double-inclined plane, made of wire, and intended for suspension. The splint is placed above the limb instead of underneath.

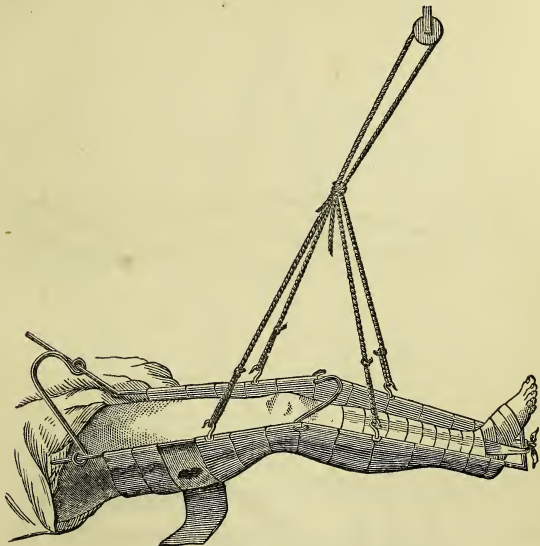


Fig. 65.

Mr. Hamilton, United States Army, describes the splint as follows :—  
 “Smith’s splint is composed of a frame made of stout wire (size No. 10), fig. 66. Its length should be sufficient to extend from the anterior superior spinous process of the ilium, to a point beyond the toes, the lateral bars being separated three inches at the upper end, and two inches and three quarters

at the lower end. Before being used it is covered with cotton cloth, to protect the limb from immediate contact with the wire. The limb is then

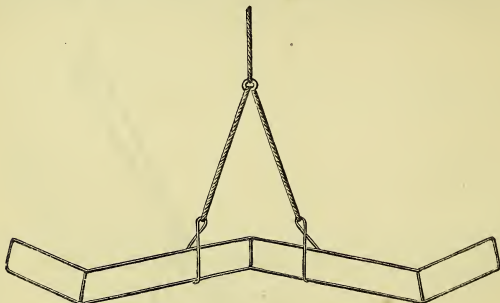


Fig. 66.

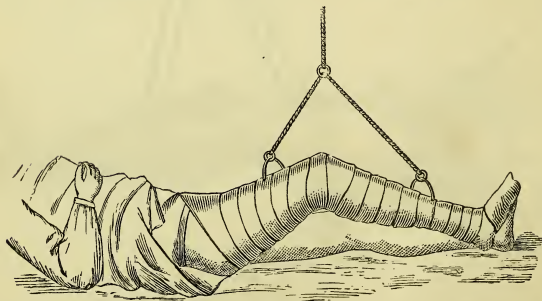


Fig. 67.

secured to the splint by successive turns of a roller from foot to groin (fig. 67).

“When this splint is applied to a broken femur, one of the hooks, to which



the suspending cords are attached, should be made fast to the splint about opposite the seat of fracture, and the other should be secured a little above the middle of the leg; while the point of attachment in the ceiling, or to the frame from which the suspension is made, should be a little in advance of the knee, and not perpendicularly above it; this will secure a certain amount of extension and counter extension upon the thigh.

"The principal objection to this splint is the difficulty of applying it

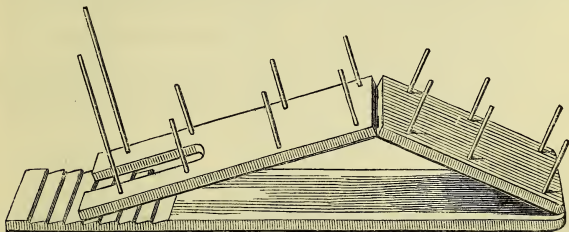


Fig. 68.

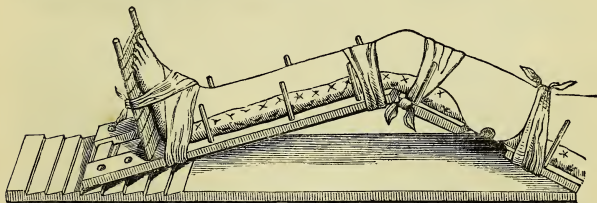


Fig. 69.

and the roller from time to time, without disturbing the limb at the seat of fracture. The limb is also liable to be bent at the point of union."\*

Professor Esmarch, in his work on bandaging, 1866, describes a splint for gun-shot fractures of the thigh, which is very easily made, portable, and can be used for placing the limb in a straight or double-inclined position. It consists of two planks, on which the upper and lower leg are

\* Hamilton's 'Military Surgery,' p. 411.

to be laid, and which are united by two hinges. There is a third plank, to which the plank to support the thigh is attached by means of a hinge, and which admits of movement to any angle of the thigh and leg planks. To keep the foot firm, there are two ten-inch pegs, which, with a bandage, are connected with one another to form a foot support, so that the foot can be pressed against it. Similar, but smaller, pegs are placed in the sides of the plank, fixed on both sides, so as to keep the pads in position. If it is necessary to raise the foot, a brick should be placed under the apparatus at that end \* (figs. 68 and 69).

It is of the greatest importance to make a good slit for the heel in the splint for lower leg, to avoid pressure.

In compound fractures, where the aperture exists in the posterior and outer part of the limb, Erichsen has found a long splint, made of oak, and bracketed opposite the seat of the injury, the most convenient apparatus,

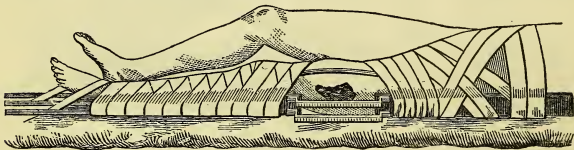


Fig. 70.

enabling the limb to be kept of a proper length and the wound to be dressed at the same time (fig. 70).†

Deputy-Surgeon-General Gordon describes the "appareil Bonnet" which he saw used in Paris during the siege (fig. 71). He says: "It is, perhaps, the best and most convenient kind of apparatus for treatment of gun-shot wounds in the lower extremity." The sketch will illustrate its construction and mode of application.

"A very short time is sufficient to enable a workman to so modify the apparatus that a piece may be taken out and secured upon moveable hinges, to enable the surgeon to attend to the wound, whatever be its position, the apparatus having an opening in which the nates rest. For fractures of the femur it is very convenient. The position of the perineal belts is seen in the illustration, and extension at the foot may readily be ensured by means of straps secured to buckles at the end of the foot-pieces or to the bedstead."‡

\* Esmarch on 'Bandaging,' p. 62.

† 'Science and Art of Surgery,' by J. Erichsen, vol. i., p. 294.

‡ 'Lessons in Hygiene and Surgery,' by Dr. Gordon, p. 129.

Professor Esmarch, in speaking of the appareil Bonnet, says they are convenient for the treatment of fractures of the lower extremities, but that they are expensive ; that they take up much room ; and that it is difficult to have a sufficient number of them of different sizes.

Professor Stromeyer has designed a fracture box, which may be used

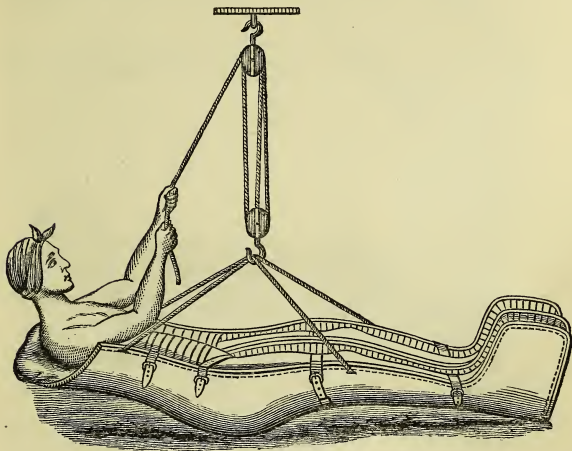


Fig. 71.

for fractures of the thigh or leg, but appears best suited for the latter (fig. 72). It consists of a double-inclined plane, supported on a frame, with hinged brackets, which can be moved so as to place the box at a convenient angle.

The thigh-piece, sides, and foot-board are attached to the bottom of the box by hinges, and so constructed that all fold into one convenient package.\*

The sides and foot-board are perforated to admit of bandages being

\* This apparatus is in the Museum, Royal Victoria Hospital, Netley.

passed through. An intelligent carpenter should be able to make an apparatus of this kind in a short time.

Legouest gives an account of an apparatus for fractures of the thigh designed by Sarazin, which, he says, has all the mechanism for extension and counter-extension. It is composed of metal gauze for enveloping the foot, leg, thigh, and pelvis, and is fashioned to certain shapes, so as to fit the limb accurately (fig. 73).

Placed on the inside of the limb, but outside the gauze, is a long wooden splint divided into two portions at the level of the knee, but joined by means of an iron plate fixed to the lower portion, which works in a mortice

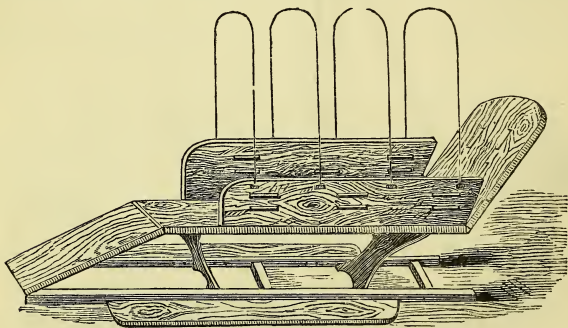


Fig. 72.

in upper portion (fig. 74), where it can be secured with a strong screw. By means of this contrivance extension can be made from lower limb, and maintained by tightening the screw.

The splint and gauze are kept in position by means of the belt round the pelvis, and several straps with buckles round the limb, the straps being secured to wooden splint by means of flat-headed nails. In applying the splint, the limb should first be enveloped with cotton wool. Should the apparatus not be found sufficiently strong, it may be supplemented with a splint passed under the straps. The gauze is easily cut by strong scissors or with a mallet and chisel on a hard plank; after which the edges should be turned up to prevent fraying, or they may be bound with leather.

Should there be a wound, an aperture may be cut in the gauze for the purpose of cleansing it, and applying dressings; but this is scarcely necessary, it is so easy to open the apparatus without disturbing the limb.

Fig. 75 represents the different parts of the apparatus, with measurements for a man of ordinary height.

*Gun-shot fractures of the leg*, uncomplicated with injury to great vessels and nerves, or when the knee and ankle are not implicated, admit of an attempt being made to save the limb; splinters should be removed, and irregularities sawn off, if necessary.

Guthrie recommends that the leg should be placed in the straight position on the heel as a general rule, admitting of few exceptions.\*

Numerous splints of different designs and composition have been invented for fractures of the leg, but all tending to the one object—that of fixture. On the field, when the sufferer may have to be moved, the plaster of Paris bandage will be found most convenient. In the subsequent treatment, when placed in a fixed hospital, he will derive great comfort from a common box splint with sides, so arranged with hinges that they can be let down to examine wound without disturbing limb. If the flesh wound is not extensive, the limb may be put up with the ordinary side splints with pads, and the whole placed in "Salter's Sling."

The limb may also be placed on the double-inclined plane of McIntire, which appliance answers on

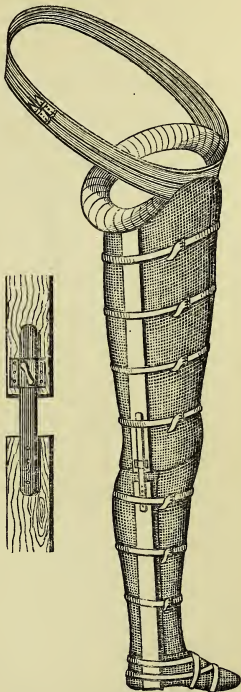


Fig. 74.

Fig. 73.

\* Guthrie's 'Commentaries,' p. 150.

service for fractures of the thigh as well, and with a firm bed gives great ease and comfort to the sufferer.

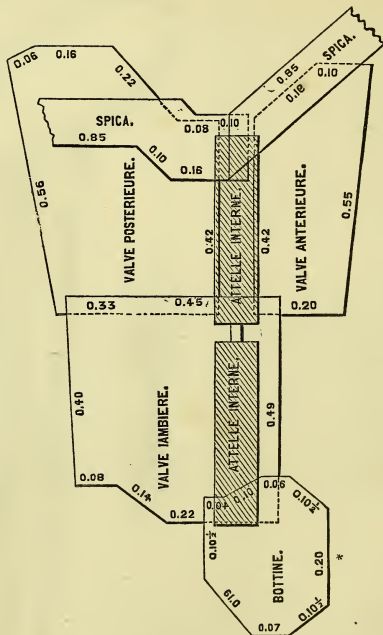


Fig. 75.

Mr. Hamilton is of opinion that, when both bones are broken completely asunder by a rifle-ball or other large shot, the surgeon will not often find it

\* French measurement. 1 centimetre = 0.39371 inch.

prudent to attempt to save the limb. "In general," he says, "the comminution is even greater than in fractures of the femur. If an attempt is made to save the limb, loose floating fragments must be removed and the limb placed in an easy position, being sustained by moderate lateral pressure. Neither extension nor counter-extension can generally be made to any purpose.

"It is impossible to lay down any absolute rules as to the position which the limb should occupy; sometimes the fragments will be found most at rest when the leg is made straight upon the thigh; but in the large majority of cases the position of moderate flexion will be required, the limb either resting upon its side, as recommended by Pott, or upon its posterior surface, as is most generally practised.

"Whatever form of apparatus may be used, the foot will require always the support of a foot-board, and the heel must never be permitted alone to sustain the weight of the foot." He recommends "a box containing bran, as suggested by Barton, of Philadelphia, as being specially convenient in warm weather, when maggots are apt to infest suppurating wounds. A box constructed for this purpose should be two or three inches longer than the leg, measuring from the middle of the knee, and three inches wider than the diameter of the limb at its widest part.

"To prevent the bran from escaping, a piece of cloth longer than the leg, and about two feet wide, should be laid inside the box, the bran to be poured into the cloth until the box is about one-third full; upon this the limb is to be carefully placed in a straight position, and the free upper extremity of the cloth being pinned snugly round the thigh, just above the knee, the bran must be again poured in on each side of the limb, in contact with the skin, and packed with the fingers. If the wound is covered with lint previously spread with simple cerate, the bran may envelope the whole surface."\*

In compound fracture of the tibia, occasioned by direct injury, as by a kick from a horse, which is not an uncommon accident in the mounted branches of the service, it is most injudicious to attempt to heal the wound by placing on it a piece of lint soaked in blood, as it only becomes hard, and prevents the escape of matter, which invariably follows such an injury, and if checked sets up irritation and inflammation; the limb becomes swollen and painful, irritative fever supervenes, and relief is not given till the wound is opened and there is free evacuation of the discharge.

"Hæmorrhage," remarks Mr. Erichsen, "is a common complication of compound fracture of the leg. When venous and moderate in quantity, it may be arrested by position and cold. When arterial and abundant, proceeding from laceration of one of the tibials, the line of practice to be adopted must to a great extent be determined by the situation of the fracture and of the concomitant arterial wound. If these be anywhere above

\* Hamilton's 'Military Surgery,' pp. 415, 416.



the lower third of the limb, it is useless for the surgeon to attempt to secure the bleeding vessels by groping amongst and under the deep muscles of the limb, infiltrated and disorganised as they are by the injury and by extravasation. It is equally futile in these cases to ligature the superficial femoral artery; such an operation either fails in arresting hæmorrhage, or, if it stops the circulation sufficiently for this, gives rise to gangrene. There is, consequently, no resource but amputation, and the sooner this is practised the better will be the patient's chance of recovery.\*

*Wounds of Joints.*—In the treatment of wounds of joints much of the success will depend upon the size and description of joint (wounds of ginglymoid joints being considered more dangerous than ball and socket, and more liable to be followed by tetanus), the extent of injury done, the age and constitution of the sufferer, and the time after receipt of injury that treatment has been commenced, and the available means for carrying out that treatment.

Mr. Alcock divides the prospect of success in such injuries into three divisions, which are as follow, and which embrace most important circumstances for the consideration of the surgeon:—

1. Favourable circumstances: Cases admitted into a large, well-organised, and commodious hospital an hour or two after the injury was inflicted, and then treated to the end, under the same medical superintendence and with all essential means for good treatment.

2. Partially unfavourable circumstances: Cases not immediately received into a well-organised hospital, subjected to some leagues of transport, or passing part of the first period in a field hospital with deficient means, or received into a permanent hospital with lax discipline.

3. Cases treated under unfavourable circumstances, or those admitted into crowded hospitals with epidemics prevailing; means, either personal or material, not fully adequate; with cases of wounds inflicted after a reverse in the field, or long subjected to deficient means, discomfort, and imperfect discipline of temporary field hospitals, with one or two days' subsequent transport to permanent hospital station.

Patients who have undergone excision or resection require constant care and attention, abundant cubic space, and pure air; every facility for securing cleanliness, proper dieting, nursing, surgical skill, and most perfect rest. The suppuration, as a rule, is always copious, and there is great susceptibility to pyemic poisoning. It is, therefore, necessary to calculate as to the possibility of securing favourable conditions before resection or excision is elected in preference to amputation, this operation not requiring the same amount of attention in the after-treatment, or the same prolonged rest and confinement indoors.

Professor Hannover, of Copenhagen, is not favourable to the operation of

\* Erichsen's 'Science and Art of Surgery,' p. 302, vol. i.

resection of joints. In his writings he says that he has formed his opinion on the cases he has seen among the Danes who were wounded during the war between Germany and Denmark in 1864, and, being one of the members of the Pension Committee, has had an opportunity of annually inspecting these cases. "In the majority of instances the patients reported to be cured were left with useless dangling limbs, and the Danish surgeons, as well as the patients, both agree that amputation would have been preferable; for it would have saved the latter from being burdened with limbs which are not only cumbersome and powerless, but also sources of frequent pain, atrophy of the extremity in which the resection has been performed, coldness, numbness, and contractions."\*

Professor Hannover's remarks have been reviewed, and the reviewer naturally points out that most surgeons must be familiar with some cases in which not only full use of the hand and fingers has been retained after resection of one of the large joints of the upper extremity, but considerable power in certain movements of the whole limb. Even one such successful instance is sufficient to annul a general condemnation of the operation itself.

Dr. Loeffler, of the Prussian Medical Military Service, who, it appears, operated in some of the cases referred to by Professor Hannover, says that in various instances the Professor has relied upon certificates furnished by surgeons in different parts of Denmark, not for scientific purposes, but with the object of showing the necessity for a continuance of the pension to the invalided soldiers who had been the subjects of the wounds which led to the operation of resection.†

It is quite possible, as Dr. Loeffler suggests, that the same attention may not have been given to the after-treatment as in Germany, and that the climate of Denmark is not very favourable for patients after resection.

Dr. Stromeyer and other German surgeons lay particular stress on the after-treatment of resections. And the writer, from his own experience in these cases, has no doubt that, when successful, their success was due to special care in the subsequent treatment; it would, therefore, be unjust to condemn the operation of resection until some further evidence has been adduced against it.

Stromeyer is in favour of primary operations for resections, and does not approve of allowing cases for primary resection to drift into secondary, in order that they may be performed subperiostally. He considers the advantages of the sub-periosteal resection to be exaggerated.‡

Mr. Erichsen, in his valuable work on surgery, gives the following as indications for excision:—

1. Excision may be required in bad compound dislocations and fractures

\* 'British Medical Journal,' January 15th, 1870.

† Ibid., May 28th, 1870.

‡ Ibid., September 23rd, 1871.

into joints, especially in gun-shot injuries, more particularly in those of the head of the humerus and of the elbow.

2. As a substitute for amputation in cases in which the joint is so extensively diseased that the patient will be worn out by the discharge or pain unless it be removed. Here a useful limb may be secured by the sacrifice of the diseased part.

3. In some cases of articular disease, in which amputation would not be justifiable, excision may be done in order to hasten the cure, and thus to save years of suffering to the patient.

4. Excision may be done in cases in which amputation is not practicable, as in disease of the hip-joint or of the temporo-maxillary articulation.

5. As a substitute for other and less efficient treatment, in order to restore the utility of a limb or joint, as in osseous ankylosis of the elbow, or in faulty osseous ankylosis of the knee.\*

Legouest considers that "the indications for excision are—when the lesions of bone are limited and the vessels are intact, when the lesions of the soft parts are to small extent, and when it is possible to preserve a certain number of muscular insertions round the joint."

*Gun-shot and other Wounds of the Shoulder-joint.*—Should the joint be laid open by a sabre cut or slightly wounded by a rifle bullet, the soft parts not much lacerated, no large vessel or nerve wounded, and the constitution of the sufferer good, the wound ought to be closed with the least possible delay, and by careful attention and dressing and keeping the limb at rest, recovery may take place. If, however, the head of the humerus is splintered, the articulating surface injured, the soft parts only slightly damaged, and no wound of great vessel or nerve, the operation of excision is now advocated, which in the hands of British surgeons has been found most successful and has given the sufferer a comparatively useful limb.

Mr. Hennen, writing in 1818, says : "The operation of excision of the head of the humerus, as recommended and practised by Boucher, Thomas, Moreau, and other French surgeons, and by White and Park in England, is a proposal well known to all military surgeons. It is not, however, one generally adopted. I have never seen it performed on the field, and in hospital practice I have only seen one case of it. The frequency of its performance by M. Larrey and Guthrie should encourage us to hold the plan in view; but I have not enlarged upon it as a field operation." †

Professor Longmore records that, during the Crimean War, of thirteen resections of the shoulder-joint in the English army, there was only one death; eight of these were primary and five secondary operations; and that during the New Zealand campaign several resections were performed with remarkably successful results.‡

\* Erichsen's 'Surgery,' vol. ii., p. 179.

† Hennen's 'Military Surgery,' p. 39.

‡ Longmore on 'Gun-shot Wounds,' p. 221.

*Wounds of the Elbow-joint.*—The bones forming the elbow-joint may be slightly injured by sabre cut, bullet, or fragment of shell. In the event of the external wound being slight, and the bone only partially damaged, that is, splintered about the condyles, olecranon, or radius, or if a bullet or other foreign body is lodged in the lower end of humerus or condyles, it will be necessary to remove splinters or fragments, elevate foreign body, close the wound, and follow out a strictly antiphlogistic treatment. The joint will in all probability be stiff, but the patient will have the advantage of a forearm and hand; and here it is that experience may do so much in saving a wounded soldier from excision or amputation. By careful examination with the finger immediately, or as soon as possible after receipt of injury, the exact condition of the joint may be ascertained, and the necessary operative measures at once carried out.

Guthrie observes: "When the articulating ends of the humerus, radius,

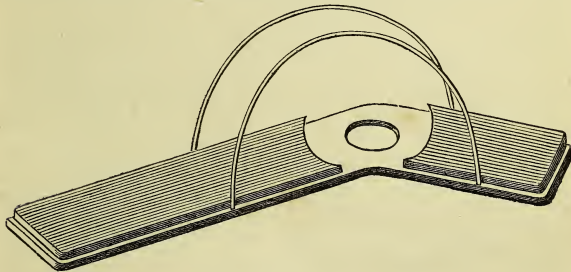


Fig. 76.\*

and ulna are wholly or in part injured by a musket-ball, it was formerly the custom to amputate the arm in such instances of great mischief; an operation which should be superseded by that of excision of the joint."

Excision of the elbow-joint, in the hands of British military surgeons, has been attended with most happy results. The writer has seen some useful limbs after the operation, capable of lifting weights, and unaccompanied by pain and numbness.

For the more convenient treatment of excision or resection of the elbow-joint, Dr. Stromeyer designed a splint which Professor Esmarch has improved upon, whereby the arm can be raised up, without the joint being

\* The wire should be represented as fastened to upper splint.

disturbed. This splint is made from two of Stromeyer's arm splints, of which the under one is uncushioned, but the upper one is stuffed with wadding and covered with oilcloth, and at the region of the elbow a wedge-shaped piece is sawn out (fig. 76). The upper arm-piece of this splint is retained in position with forearm piece by means of two hoops of strong wire. The arm rests on this splint, which can be raised by means of the wire, while the bandages and dressings are quickly removed from the lower splint, and after it has been cleaned and wound dressed, can be replaced.

Numerous contrivances have been invented for placing the elbow on after resection, but an ordinary soft pillow answers all purposes, on which the limb should rest in nearly the extended position, so that the cut portions of the bones may be in close approximation with one another.

"At the end of a week or ten days, when granulations have sprung up, the arm may be put on a slightly bent leather splint, and as the healing goes on this may gradually be flexed, until at last it is brought to a right angle.

"Until the contraction of the cicatrix has fully taken place and the neighbouring tissues are quite firm, the joint should be supported by one lateral leather splint on the inner side of the arm. The splint should then be removed, the arm put in a sling, and passive motion had recourse to, in order to prevent osseous ankylosis."



Fig. 77.

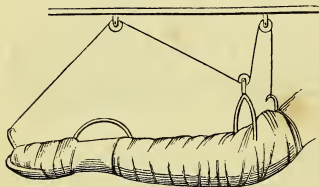


Fig. 78.

*Gun-shot Wounds of the Wrist-joint.*—The wrist being a complicated joint injuries to it are liable to be followed by most serious results, and, as the structures are so superficial, resection as a primary operation is not likely to be followed by favourable results. Its close connection with flexor and extensor tendons renders them liable to consolidation with their sheaths, and stiffness of the joints. For secondary operations, Mr. Lister has endeavoured to obviate this stiffness by suitable after-treatment.

Mr. MacCormac reports most favourably on an apparatus of Professor Esmarch for treating cases of resection of wrist-joint. "The hand and arm

are placed in a prone or semi-prone position on the splint (fig. 77), whose form is such as to leave the wrist exposed and easy to be got at for the application of dressings. The whole apparatus *en fonction*, consisting of a suspending rod, a plaster of Paris or other form of bandage, and the splint, is represented in fig. 78, and the facility with which the patient can move about in bed, or readjust the position of his arm, is at once perceived.\*

When the wrist is so severely injured as to preclude all hopes of saving it, amputation through the joint may be had recourse to.

In applying bandages to the wrist, the fingers should be left free, and occasionally moved, to prevent ankylosis.

*Wounds of the hip-joint* by a bullet penetrating, or imbedding itself in, or breaking the head or neck, or splintering in the direction of the shaft, form a class of grave wounds.

In wounds of the head, neck, and trochanter, splintering into the joint, if the limb is not amputated or an attempt made at excision, the case will prove fatal. Surgeons in former days looked upon wounds of the hip as certain death, but now there is some hope if excision or amputation be performed or if splintered bone be removed.

Mr. Hennen considers that injuries occasioned by balls lodging near or about the joint of the hip are among the most serious in military surgery. The fever, the profuse discharge, the tedious exfoliation, all tend to sink the patient, and are but too often fatal. In some of these cases, the course of the ball is so obscure, and its place of lodgment so uncertain, that it can only be detected after death.

Mr. Guthrie lays it down as a principle that in all cases of accident, whether from shot, shell, or railway carriage, no man should suffer amputation at the hip-joint when the thigh bone is entire. It should never be done in cases of injury when the bone can be sawn through immediately below the trochanter major, and sufficient flaps can be preserved to close the wound thus made. Cases requiring amputation at the hip-joint are for a wound of the artery accompanied by a fracture of the femur, or in the event of the principal artery being wounded during the course of treatment.

The operation of excision was performed in the Crimea, in the Schleswig-Holstein campaign, and during the American War of the Rebellion; but the result has, with a few exceptions, been far from satisfactory.†

The operation was first recommended by Mr. Guthrie as a substitute for amputation at the hip-joint; he limited the operation to injuries of the head and neck of the bone, or with little extension beyond these two parts.

Mr. Hamilton considers that when a ball has entered the head, neck, or

\* 'Notes and Recollections of an Ambulance Surgeon,' p. 104.

† See Circ. No. 2, Surg.-Genl. Office, Washington, Jan. 2, 1869 Report by Assist.-Surg. G. A. Otis.



trochanteric portion of the femur, if any surgical operation is demanded in these cases, it is exsection.\*

Legouest, in referring to gun-shot wounds of the hip-joint, says: "Disarticulation practised immediately after receipt of a wound has given such bad results, that one cannot but applaud the efforts which have been made by military surgeons to replace it by resection, but yet there are cases when this operation is indispensable. In comminuted fractures of the upper parts of the femur, caused by large projectiles, when the bone is much broken and when there is much loss of the soft parts, removal of the member is almost always necessary."

In fractures of the upper part of the femur, when the fracture does not extend beyond the trochanter or is in the trochanter itself, recovery is possible without other operation than extraction of the splinters.

*Wounds of the knee-joint* are most serious. The admission of air into a large sac, lined by synovial membrane, producing inflammatory action; the missile probably injuring the cartilage and bony structures, the drain on the constitution by profuse suppuration, with, in all probability, diarrhoea, hectic and blood poisoning, render these injuries beyond hope of recovery without surgical interference.

The treatment generally admitted as being the best is that of amputation, but there are some few advocates for conservatism or resection.

Hennen, after his great experience, says: "In my own practice I have met with only two cases where the limb was saved after serious injury to the knee-joint, and in one of them only was the perfect use of it restored."†

Guthrie considers that "wounds of the knee-joint from musket-balls, with fracture of the bones composing it, require immediate amputation; for although a limb may be sometimes saved, it cannot be called a recovery, or a successful result where the limb is useless. For one limb thus saved ten will be lost."‡

Longmore speaks of gun-shot wounds of the knee-joint as being of the most hazardous nature. He is of opinion that the proper treatment of a penetrating gun-shot wound, when the diagnosis has been satisfactorily established, is generally a matter of serious doubt and difficulty. The necessity of amputation, when the articulating ends of either or of both of the two principal bones are broken, in addition to the joint being penetrated, has hitherto been generally recognised and acted upon in field practice. But the ratio of mortality in amputations at the lower third of the thigh has frequently led surgeons to resort to other modes of treatment. Resection has been tried, but with comparatively little success in field practice.

Dr. Macleod, who appears to have taken a special interest in this class of

\* Hamilton's 'Military Surgery,' p. 400.

† Hennen's 'Military Surgery,' p. 159.

‡ Guthrie's 'Commentaries,' p. 82.



wounds, visited every one he could hear of in camp while in the Crimea, and avers that he never met with one instance of recovery in which the joint was distinctly opened and the bones much injured by the ball, unless the limb was removed.\*

Stromeyer recommends primary amputation for gun-shot injuries of the knee-joint. He is not in favour of resection, and is thus opposed to Professor Langenbeck, whose system is non-interference.

Legouest doubts whether resection of the knee can ever be substituted as a general rule for amputation of thigh in army surgery. Amputation is so serious a matter, that he does not hesitate to renounce it, and to have recourse to resection under certain conditions—that is to say, when the wound is slight; when the sufferer is young and healthy; when he need not be carried any distance; when he may be placed alone in salubrious air, with all the resources of surgery and hygiene. These conditions, he says, are unhappily very rare in campaigning, and the impossibility of combating them retards the possibility of resection in the surgery of war.

Gordon mentions that during the siege of Paris the experience gained seems to have confirmed the correctness of the rule that amputation should be performed in all cases of penetrating wounds of the knee-joint; at the same time, it showed the impracticability of making it absolute, there having undoubtedly occurred some cases in which deviation from it took place with every prospect of saving the limb, although the patients had, in the first period of treatment, to suffer a degree of inflammation and subsequent suppuration that seriously jeopardised their lives.†

Excision of the knee-joint is an operation which should not be attempted unless under the most advantageous circumstances, when every possible care and attention can be given to the after-treatment; when the patient can have good air and diet, and every appliance that the surgeon may require. These circumstances are not likely to exist in the field, though they may be available in stationary hospitals.

The safest course to adopt is to amputate at the lower third of the thigh, and the sooner it is done the better, as inflammatory symptoms soon set in after such injuries, followed by suppuration of the joint; abscesses appear among the muscles of the thigh, burrowing along the bone after depriving it of its covering; the patient rapidly becomes exhausted by hectic, when interference by amputation will be too late.

When the end of the femur has not been injured, it has been proposed to amputate at the knee, leaving the bone intact; this has not been found a successful operation, as it has been attended with great suppuration, constitutional disturbance, and prolonged suffering.

Should an attempt be made to save the limb, the treatment should be

\* Macleod's 'Notes on the Surgery of the War in the Crimea,' p. 310.

† 'Lessons in Surgery and Hygiene,' p. 157.

strictly antiphlogistic, the application of cold and leeches to the joint. The joint should be perfectly fixed. Langenbeck recommends plaster of Paris bandages. There should be no pressure. Wounds should be enlarged to admit of free discharge. The diet should be good and the air pure.

It has been proposed to freely incise the joint, based on the result of accidents in civil life, where the joint has been extensively opened and very little harm followed; but what little experience we have on this subject is most unpromising.

When a ball is lodged in the joint, Mr. Guthrie is of opinion that an attempt should first be made to try and extract it without extensively opening the joint; if that is not possible, amputation or excision had better be performed. If, he says, a ball lodge in the condyles of the femur within the capsular ligament, and cannot readily be extracted, the wound should be healed as soon as possible, and although it may cause some little inconvenience to the knee-joint, the limb and the life of the patient may be saved.

*In incised wounds of the knee-joint*, if not complicated, it is best to try and save the limb, by bringing the edges of the wounds together by means of silver wire sutures; exclude the air, and keep the joint at perfect rest. Instances are on record of recovery from such injuries.

*The patella* is occasionally fractured with a bullet or other missile, and if complicated with injuries to the other bones it will be impossible to save the limb. Should, however, the patella be struck in front and only split, an attempt should be made to save the limb.

In all injuries to the patella the limb should be placed in the straight position, with a well-padded splint underneath, and heel slightly raised.

*Wounds of the Ankle-joint.*—In these injuries much depends on the amount of damage done to guide the surgeon in the treatment. If the bones are not extensively injured, and the posterior artery and nerves intact, an attempt should be made to save the foot; but, like all injuries to joints in which the surgeon might wish to save the limb, and indeed where it might be considered advisable, the circumstances as regards care, attention, &c., as already described, should influence him.

Stromeyer, in wounds of the tibio-tarsal articulation, recommends the expectant treatment. He is opposed to resection of this joint, which was not successful in the war of 1870-71. His plan of treating gun-shot wounds of the ankle is simply to keep the parts perfectly immovable, and extract the pieces of splintered bone as they become detached.

Langenbeck is in favour of resection, which operation he performed with success in the German-Danish War of 1864, and the Bohemian War of 1866. He has had nine recoveries out of eleven operations. He recommends sub-periosteal resection, and complete immobilisation of the parts after the operation.

Erichsen considers that if the bones be not too extensively comminuted, an attempt, and probably a successful one, may be made to save the limb. In such cases, extraction of fragments and excision of the splintered ends are necessary; and modified operations, partial excision by means of gouge, forceps, and Hey's saw, will be found more successful than the formal operation.

If the large vessels and nerves have been cut across, and the bones very extensively shattered, amputation will be the proper course to pursue.

Legouest admits there are many instances of success when resection of the ankle-joint has been performed, but considers that the seriousness of lesions of this articulation, the danger of the operation, and the uncertainty of definite results, justify him in rejecting resection of this joint in a general way, as he has already rejected that of the wrist.

*Wounds of the Foot.*—The bones of the foot, when injured by rifle-ball or other missile, present, as a rule, serious complications—being numerous, of soft texture, and liable to run into a state of caries from the slightest injury.

There may be injury of some of the many tendons, of the vessels, nerves, and strong fascia.

It is difficult to extract splinters or foreign bodies, and, if the wound of the bone is extensive, an attempt to save the foot is not recommended, as the disease produced will ultimately render amputation necessary, which, if done at first, would prevent much suffering. When it is decided to interfere by operation, the foot, or part of it, should be removed as soon as possible.

A missile will sometimes lodge in one of the bones forming the foot, doing but slight injury to the surrounding textures. An attempt should then be made to remove it or the bone.

*Wounds of Bones of the Toes.*—In wounds of the bones of the toes, only such as are extensively fractured, or when the tendons and vessels are torn, should be amputated. Much can always be done by removal of splinters of the bone, foreign bodies, and strict antiphlogistic treatment.

## WOUNDS OF NERVES AND TENDONS.

NERVES may be injured by contusion, compression, or distension, by laceration, by partial or whole division, by puncture or incision. Foreign bodies may be imbedded in them, or they may be included in a ligature, any of which may give rise to most serious symptoms, both local and constitutional—such as intolerable pain, inflammation, contraction of muscles, tetanus.

*Treatment.*—If exposed, the parts must be thoroughly cleansed, and all foreign bodies removed that may be present, healing by the first intention being promoted and perfect rest secured to the sufferer. The local application of leeches, fomentations with poppies, poultices, or cold applications to the neighbourhood of the wound, according to the sensations of the patient, as some will appreciate heat, and others cold. It may be necessary to administer purgatives.

When the inflammation runs high, benefit may be derived from antimony, opium, or hyosciamus, the antimony being in sufficient quantity to keep up a state of nausea.

After a wound has healed, the cicatrix may press on a nerve and cause great suffering. Friction and gentle exercise may relieve the symptoms. Warren has dissected the nerve from such a position, without dividing or otherwise injuring it.

The local application of belladonna, chloroform, aconite, blisters, subcutaneous injection of morphia, administration of mercury, or division of nerve may be tried.

TENDONS may be divided by sword-cut or other sharp weapon, or ruptured by over-exertion, when it will be necessary to place the limb in such a position that the muscles may be relaxed, and so approximate the divided ends. When union has taken place, the suppleness of the parts should be restored by friction and warm sea-water douches, for, if neglected, stiffness and weakness of the limb may continue for a long time.

When the tendo-Achillis has been cut or ruptured, an apparatus may be constructed by placing a strap, like a dog collar, above the knee, from which a cord is attached to a loop in the back of a shoe or slipper; by tightening the cord the muscles are relaxed.

When the exterior tendons of the fingers are divided, the hand must be placed in the straight position by being laid on a splint.

## ANÆSTHESIA.

*Chloroform.*—The use of chloroform as an anæsthetic in mitigating the sufferings of wounded men and of patients undergoing operations, has been admitted by all as one of the greatest blessings.

When possible, it should be administered for all operations, and for dressing wounds when the subjects are very sensitive, the usual precautions being adopted as regards the wishes of the patient, the condition of the circulation, respiration, and having at hand means for using artificial respiration, galvanism, ammonia, and a forceps or hook for drawing the tongue forward. The experience of the writer is that recently wounded soldiers are very easily placed under the influence of chloroform, much more so than chronic cases, and that it decidedly relieves the nervous shock. Recently wounded require no preparation for its administration, but in chronic cases it is always best not to give food for two or three hours beforehand; but a little stimulant, such as wine or brandy, about half an hour before the chloroform is administered.

As a guide to complete anæsthesia, Bryant lays down the rule that, "When the upper eyelid can be raised without muscular resistance, and no muscular contraction is caused by touching the cornea, the patient is, as a rule, sufficiently under the influence of the anæsthetic for surgical purposes."\*

Dr. Snow considers that "Chloroform may be given with safety and advantage to every patient who requires, and is in a condition to undergo, a surgical operation. A state of great depression from injury or disease does not contraindicate the use of chloroform. This agent acts as a stimulant in the first instance, increasing the strength of the pulse, and enabling the patient, in a state of exhaustion, to go through an operation better than if he were conscious."

Chloroform and other anæsthetics should be most carefully treasured by the army surgeon, and no waste allowed. It is sometimes difficult to procure it in sufficient quantity, especially after severe engagements, when every drop is worth its weight in gold.

*Ether* is now much used by the Americans, and has obtained the credit of being much safer than chloroform. It has, however, two great disadvantages, which are, that it requires a large quantity to produce anæsthesia; also, a bulky instrument for its administration—both of some consequence

\* 'The Practice of Surgery,' by Bryant, p. 1019.

on active service. I have frequently administered it with Mr. Morgan's apparatus, and found it highly satisfactory.

Ether having the reputation of being safer than chloroform, it is a matter worthy of consideration whether the inconvenience attending the weight and bulk of the inhaler should prevent its being used in warfare. Our combatant brethren never hesitate to transport enormous implements of destruction!

*Shock.*—The constitutional disturbance which takes place on a man being wounded is described as the shock. This differs in severity in different subjects, being influenced by moral character, intelligence, state of health, and nature of wound. It has also been stated that conical bullets from a rifle cause greater shock than round. As a rule, the greater the injury the more intensified the shock. At the same time there are examples of very severe wounds and but little shock, and *vice versa*. Mr. Guthrie mentions a case of a soldier at Talavera, who was struck on the head by a 12-pound shot, which drove some bone into, and some brain out of, his head. He was walking about, complaining but little immediately after the accident, although he died subsequently. My experience is, that all wounded suffer to a greater or lesser extent from shock, which manifests itself in feebleness of pulse, cold perspiration, change of colour, and disquietude of mind; the more aggravated form, where large joints are injured, long bones fractured or cavities opened, being fainting, mental agony, loss of reason, convulsions, hiccup, vomiting, irregular chills, sense of weight, collapse, all of which are most unfavourable symptoms, and their continuance sufficient to cause great alarm.

The shock may not be established for some little time after receipt of injury, an interval which differs in duration, mainly in accordance with the severity of the wound, the agency by which the injury has been inflicted, and probably the constitution of the patient.

The treatment consists in administering consolation or encouragement, cordials, beef tea, wine, or brandy.

## AMPUTATION.

UNDER this heading will first be considered the question as to the proper period for performing amputation for wounds requiring it in warfare; secondly, cases demanding it; and, thirdly, the most approved methods of operating.

As to the proper period for amputating, the subject has been pretty well discussed and exhausted years ago; but in an essay like this, it may be as well to give the opinions of some competent authorities:—

Ambrose Paré considered amputation should be performed while the wounded were in sight of the battle-field.

Wiseman recommends to cut off the limb while the soldier is heated and in mettle.

Hunter is of opinion that amputation should not be performed until subsidence of the first inflammation. He probably formed his opinion from cases occurring in civil practice.

John Bell, writing in 1800, after describing wounds in which the loss of the limb is inevitable, says, "Amputation should, in those cases where the limb is plainly and irrecoverably disordered, be performed upon the spot."

Mr. Hennen remarks, in his work, 1818: "The propriety of amputation in the field being admitted, the question naturally suggests itself, What is the proper period—instantly on receipt of the wound, or consecutively? The practical reply is with as little delay as possible." He, however, further on, qualifies this by saying (referring to the surgeon), "But he will betray a miserable want of science, indeed, if, in the crowd of sufferers, he indiscriminately amputates the weak, the terrified, the sinking, and the determined. While he is giving his aid to a few of the latter class, encouragement and cordials will soon make a change in the state of the weakly and terrified. When, therefore, he finds a patient with feebleness and concentration of pulse, faintness, mental agony, loss of reason, convulsions, hiccup, vomiting, irregular chills, with stiffness of the whole body, universal feeling of cold and numbness, with sense of weight, change of colour, and other symptoms of collapse, he waits patiently for a return of life—he administers wine, warmth, and cordials."

Mr. Longmore considers that, in respect to the particular time at which primary amputation is to be performed, the general practice of the present day is, when the operation is inevitable, to perform it as soon as it can be



done, provided the more intense effects of the "shock," where it has supervened on the injury, have passed away.

Mr. Guthrie is of opinion that when the wound of an extremity is of so serious a nature as to preclude all hope of saving the limb by successful treatment, it should be amputated as soon as possible; and, further, the advantageous results of primary amputations, or those done within the first twenty-four hours, or at most forty hours, over secondary amputations, or those done at the end of several days, or of three or four weeks, have been so fully and firmly established as no longer to admit of any dispute.

In the German medical service primary amputations are discouraged at the bandage places on the field of battle; which the writer believes to be in consequence of an operation of the kind taking up so much of the surgeon's and attendants' time, when other wounded might be relieved, and not from any want of appreciation of the value of primary operations.

There is no doubt that to perform primary amputation or resection for all cases requiring them on the field, would necessitate a very large staff of surgeons, and consequently these operations can but seldom take place at the first line of surgical assistance.

Amputations in warfare have for a very long time been divided into primary and secondary, by which is understood amputations performed immediately after receipt of wounds, or at an indefinite period, without reference to condition of the patient. Mr. Alcock has introduced a third period, "the intermediary;" which three have been accepted by many surgeons to denote periods in which amputation may or may not be performed, but with reference to local conditions.

Mr. Alcock observes: "The generality of authors, in defining primary and secondary amputations, confine the one to the first period, and the other to the third; what, then, becomes of the second?" It is not enough, in his opinion, to say "there are two sets of operations, primary and secondary; the greater mortality is in the latter, therefore the former is the most advantageous—a summary mode of settling the question, which would be most desirable were it just and conclusive, as the numerical difference is distinct. There are, at least, certain classes of causes the influence of which should be correlative and equal in the two opposing sets of operations before the numerical comparison of results can be final." These he considers are: 1. The nature of the original injury. 2. The general constitution, depending upon the organisation and previous health and habits of the patient, and the particular condition of the period referred to. 3. The mode of operation (in which the time occupied is included), and a great variety of circumstances, some easily, and others with difficulty, appreciated and defined. 4. The after-treatment, with which the *locale*, the state of the atmosphere, and many other features enter. 5. The complexion of the mind, and the consequent mental influence which may be beneficial

or deleterious to a high degree. He defines the three periods as follows:—Primary, or the period between the receipt of the injury and the appearance of inflammatory symptoms; intermediary, or the period when the inflammatory action has commenced, and is more or less capable of disturbing the animal economy; secondary, when the violence of the inflammatory symptoms and sympathetic fever have abated, that is, when the suppurative stage is fully established.

Mr. Hamilton divides the periods into immediate, primary, secondary, and intermediate. The first period, or immediate, are those which are made immediately, or within a very short time of the receipt of injury. The term cannot with propriety be applied to amputations made after the lapse of ten or twelve hours. Primary amputations are those made during the first twelve, twenty-four, or thirty-six hours; but not until after the severity of the shock has passed off, or more or less complete reaction has taken place in the general system. Secondary amputations are those made after the inflammation consequent upon the injury has in some measure, if not altogether, subsided, when suppuration has commenced, or even at a much later day.

The intermediate period, or that intervening between the primary and secondary periods, he calls the period of congestion or of inflammation, and points out that the dangers of amputation at this period cannot be over-estimated.

Legouest divides the periods into immediate, mediate, and ulterior. The first are such as are performed before the phenomena of inflammation have developed themselves; the second such as are performed during the acute state of inflammation; and the third such as take place when the lesion has, so to speak, become local and assumed the character of a local affection. With regard to the first period of Hamilton, or that prior to the "shock," it has been denied by some surgeons that any shock follows a wound sufficient to prove a bar to operative measures being carried out. This opinion has been advocated by Dr. Hutchinson and other medical officers of the navy; but in their service wounded men are seen immediately after receipt of injury and before the symptoms of the shock have been established, whereas in the army the surgeon may not see the sufferer for several hours, when in all probability he has endured much suffering and may be more or less prostrated.

Mr. Macleod has observed several instances in which the shock was delayed, the depressing influence not being felt until some little time after the injury. Mr. Hamilton says that he has never met with these examples, except when some visceral lesion or the rupture of a large blood-vessel has accompanied the accident; he does not, however, deny that the nervous agitation may be delayed in some cases, but is of opinion that the condition is a rare phenomenon.

The fear of amputating, or, in fact, performing any operation for relief of a wounded soldier, in consequence of nervous agitation or shock, is, in the opinion of the writer, much exaggerated. With one exception, he has never seen the great depression so often described, and that was in a soldier suffering from shell wounds of both knee-joints received in the trenches before Sevastopol.

It is now generally admitted that when amputation is necessary, it should be performed at once, the condition of the sufferer being duly considered—that is, if the shock exists to an alarming extent, it is best to delay the operation, and administer cordials, apply warmth to the extremities, and wait till reaction is established; but if it be not very intense, the operation can be performed, under the influence of chloroform, with the most satisfactory results. Macleod remarks, with regard to the use of chloroform, that by its use the fear of intensifying the shock is obviated.

Amputations after inflammatory action has set in have been attended by most unsatisfactory results. Legouest remarks on his so-called *Période Médiate*: “It is certain that a man who is operated on the day after he was wounded is not in the same state as if the amputation had been performed immediately after the accident; he suffers more or less mentally as well as physically; but the appearance of fever is a pathological phenomenon of great importance, which marks between the period of immediate and mediate amputation a line of demarcation which it is impossible to confound.”

Operations or examination of wounds should never be performed during the period of inflammation, when the constitution is in a most unfavourable condition for such undertakings, and more liable to induce pyæmia or osteo-myelitis.

John Bell remarks on this subject: “You must never amputate during pain, fever, convulsions, great swelling of the limb, but most especially during high-coloured inflammation, which betokens approaching gangrene; then the disease is in the constitution.”

Secondary amputations are not as successful in military as civil practice, when the operation is generally performed for disease and not injury. In warfare the cases requiring it are—profuse hæmorrhage, which does not admit of the ordinary measures of suppression; gun-shot fractures, when the bones do not unite, and the patient is worn out with suppuration, irritation, necrosis, caries, and all the painful accompaniments of a shattered and useless limb; and cases when traumatic gangrene has attacked a severely contused limb.

Patients who have been subjected to secondary amputation should be placed in most favourable hygienic conditions; their constitutions having already suffered renders them peculiarly liable to the occurrence of pyæmia, sloughing, and phagedæna.

*Cases demanding amputation.*—In wounds of extremities these cases will be found described according to particular regions, but here they will be considered generally.

When a bone is fractured, and there is laceration of the main arterial trunk supplying the limb, provided the vessel cannot be tied.

When there is a fracture complicated with destruction of the principal arterial and nervous trunks occurring in the course of a large limb.

When a whole limb is carried off, a ragged stump merely being left.

When there is a comminuted fracture, accompanied with extensive lesion of the soft parts, or with rupture of the principal artery and nerve.

When a limb is completely crushed and disorganised.

When there is a compound fracture of a large limb, with rupture of the principal artery and nerve.

When the principal vessels and soft parts have been carried away, though the bone be uninjured.

Gun-shot wounds involving the interior of the knee-joint.

Extensive injuries of the shoulder, elbow, wrist, and ankle joints, may require amputation; but unless there is splintering into the shaft of the long bones, loss of soft parts, or injuries of the principal artery and nerve, resection or excision should be performed.

*Amputation and disarticulation* may be performed by the circular method, the oval, by flaps of different shapes, and by skin flaps with a circular cut through the muscles.

Much discussion has taken place as to which is the best plan during warfare. The circular method was generally practised by the German surgeons during the Franco-German War, and was attended by satisfactory results.

To decide as to the most suitable form of operation, much will depend upon the position of the sufferer, as in a permanent hospital there is no reason why flaps including muscles should not be made, the great objection to them in the field hospitals being the weight and liability to displacement in transport, causing the wound to open, and in all probability their own loss from sloughing. The operations recommended for injuries when an army is moving are skin flaps and circular cut through the muscles. The advantages of these operations are—that the flaps are not so liable to be displaced in transport; there is less care required in the after-treatment, and it has been suggested by many authorities that the skin forms a better covering to the end of the bone than muscle, and is more in accordance with nature, none of those parts of the body where there is most pressure having other covering than skin. The late Mr. Teal practised amputation by the rectangular flaps, anterior being long and posterior short. The disadvantages of this plan of operation consist in the necessity of sawing the bone at a higher point when one long flap is made, than when two shorter ones of equal, or nearly equal, length are fashioned.

In gun-shot wounds, it appears especially unsuited, as in many injuries requiring amputation good double flaps may be formed from the soft parts, and a joint saved. Take, for instance, injuries below the knee or elbow, in which, if one long anterior flap was formed, it must be at the sacrifice of the joint and the consequent increased risk to the life of the sufferer by high amputation.

*Double Amputation.*—It sometimes occurs that a soldier has two limbs so severely injured that amputation of both is necessary. The writer had an opportunity, during the Crimean War, of seeing one instance of this description of injury, in which he performed amputation of one leg above the knee, while his colleague removed the other shortly afterwards.

Double amputation has been performed at the same time by different surgeons, with a view to lessen the continuance of shock to the system by simply making one operation; but to undertake anything so serious, the surgeon must be guided by the condition of the patient, as, if he is greatly depressed with continuance of the shock, the performing of a double amputation might be followed by most serious consequences. Under such circumstances, it would be better to remove one limb first, and after the shock produced by the operation has passed off to remove the other. There is no doubt, however, that if the sufferer could bear the double operation at the same time, the prospects would be more favourable.

Amputation performed in an atmosphere disinfected by Lister's carbolic spray may be attended by most favourable results, but in the field such niceties are not always procurable; and if they were, there might not be found time to use them. In permanent hospitals, the process should be strictly carried out.

*Washing out of Stumps.*—The need for washing out clots from stumps and cavities immediately before closing them, cannot be too strongly brought to the notice of the surgeon, more especially in warm climates, where they very rapidly decompose, and cause most injurious effects.

During the Crimean War, the late Professor Porter, of Dublin, observing the great mortality from amputation, requested the writer to try the effects of washing out each stump before closing it, taking care that no clot remained. This was done by a stream of water from the spout of a kettle or an ordinary wine bottle, and with most satisfactory results, both in the Crimea and India.

Very few stumps heal throughout by the "first intention;" but the irrigation process gives them a better opportunity for doing so, and when the surgeon comes to dress the stump, he will find it free from clots, which keep up irritation and poison the patient.

*After-treatment of Stumps.*—The after-treatment of stumps in the field does not differ from that usually carried out in civil practice; but it may be necessary to transport an unfortunate sufferer with a stump or stumps

only recently made. The surgeon will then have an anxious time in so arranging that the patients are not unnecessarily knocked about. The stump should be supported by a piece of thick gutta-percha or strong board being placed underneath and secured, and the whole enveloped in cotton wool or tow. It is surprising how soldiers recently operated upon bear transport, and what very slight injury is caused by it, due attention, of course, being paid to the nature of the conveyance and efficiency of attendants.

*Maggots in Stumps.*—In warm climates maggots are very apt to infest wounds and stumps; the carbolic spray will in all probability act as a preventive to this disgusting circumstance. The writer experienced an instance of their rapid formation or generation in India after the battle of Sultanpore. He amputated the leg of a native in consequence of a gun-shot wound. The stump was dressed with lint moistened with cold water, and secured for transport. On the second day after the operation, a considerable journey having been performed, on proceeding to dress it, the inside presented a living mass of maggots, which were removed, and the case progressed most favourably. By keeping lint saturated with turpentine on the outer dressings, no more maggots appeared.

*Bloodless Operation.*—Professor Esmarch has lately introduced what is known as the "bloodless operation," whereby a surgeon can remove a limb or excise a joint below the main trunk of artery, without losing a drop of blood, and with but little assistance from others—two great advantages in warfare. He describes it as follows:—"While the patient is being chloroformed, wrap the leg in waterproof varnished tissue paper, so that pus from the wound may not soil the bandage; then, with an elastic bandage made of india-rubber webbing, envelope the limb (if the leg, from the tips of the toes to above the knee), and, by equal compression, force the blood out of the vessels of the limb. Immediately above the knee, where the bandage ends, apply a piece of india-rubber tubing four or five times round the thigh, drawing it very tight and fastening the hooks which are at one end to the rings at the other. The india-rubber tubing compresses all the soft parts, including the arteries, so completely, that not a drop of blood can pass into the part which has been tied off. It has this advantage over all tourniquets, that you can apply it to any part of the limb, and need not give yourself any trouble about the position of the principal artery. Even in the most muscular and fattest individuals, you can perfectly control the flow of blood in this simple way.

"The india-rubber bandage is now removed, and the varnished paper lying under it. The operation is then proceeded with, and having been completed, the india-rubber tubing is slowly removed. When you amputate you must loosen the tubing as soon as you have tied all the arteries that you can recognise with the naked eye, as it will be necessary to guard against secondary hæmorrhage before applying the dressings."\*

\* 'Medical Record,' 22nd October, 1873, p. 661.



Mr. Cripps, of St. Bartholomew's Hospital, London, has originated another process for "bloodless operations," which he considers is an improvement on the elastic bandage. A short india-rubber tube is used, not only to prevent the blood from returning to the limb, but also for the purpose of removing it in the first place.

The two ends of an india-rubber tube, twenty-one inches in length, and about three-eighths of an inch thick, are bound together with a piece of twine, the whole forming an elastic ring seven inches in diameter (fig. 79). A grooved reel, revolving between a double handle, completes the necessary

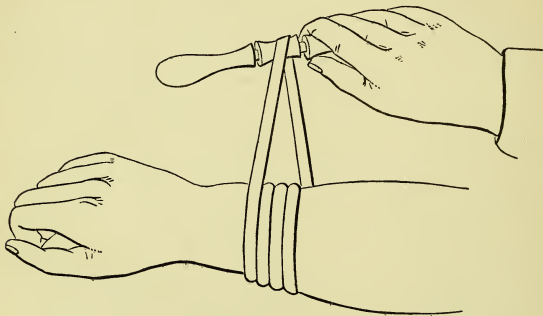


Fig. 79.

apparatus. To apply this to the arm, three or four complete turns of the elastic ring are wound tightly round the hand in such a manner as to include the fingers and thumb, care being taken that the turns lie even and do not cross one another. The reel is then put under the free portion of the ring connecting the upper and lower coil. The reel is passed round and round the limb in an upward direction; thus each coil is unwound from below as another is added above. The degree of tightness can be regulated with the greatest nicety by the distance the reel is drawn from the limb by the bandager. In applying it to the leg, it is necessary to place a pad in the popliteal space over which the coil should pass.\*

*Amputation at the Shoulder-joint.*—Hamilton, of the U. S. Army, recommends the following proceeding:—The arm lying nearly against the side of the body, with a large bistoury or a small dissecting-knife an incision

\* 'Lancet,' 11th October, 1873, p. 520.



is commenced at the middle point of the extremity of the acromion process, or two or three lines above this point (fig. 80), and carried perpendicularly downwards one inch and a half, the knife being made to cut deeply until it touches the head of the humerus ; at this point the knife is carried obliquely, and rather abruptly, outwards and downwards to the centre of the lower margin of the axilla on the under side of the arm ; in this second step of this incision, the tissues are divided down to the bone until the axillary margin is reached ; from this point to the termination of the incision, only integuments are divided, so that we may avoid wounding the axillary artery. The knife is again introduced over the head of the humerus, at the point

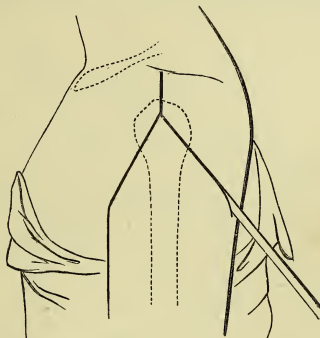


Fig. 80.

where the perpendicular incision became oblique, and it is carried down upon the inside of the arm in the same manner as we have described upon the outside.

One assistant pulling asunder the lips of the wound upon the top of the shoulder, while a second carries the elbow slightly across the body, and rotates the head of the humerus outwards, so as to expose the capsule and the long head of the biceps, the surgeon divides them with his knife, and at the same moment the head of the humerus springs from its socket.

The knife is then passed under the head of the bone from above, and as soon as the face of the instrument has fairly reached the surgical neck of the humerus, an assistant standing at the head of the patient pushes the

thumbs of both hands into the wound above the knife, while the fingers remain in the axilla, and he thus grasps and controls the axillary artery. The operation is completed by carrying the knife downwards close to the bone until the apex of the tegumentary wound in the axilla is reached, and then cutting almost directly outwards. Care must be taken not to sever the parts containing the artery until the knife has arrived at the lower margin of the axilla.\*

*Amputation at the Shoulder-joint by Transfixion.*—Lisfranc approved of this method, which Erichsen describes: "A long narrow-bladed knife should be used. One assistant must have charge of the limb; another should raise

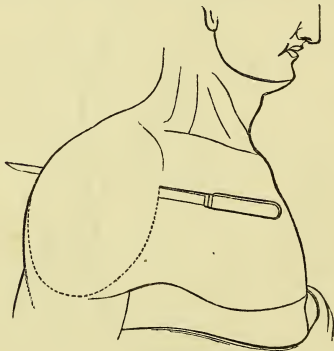


Fig. 81.

the flap; and a third must follow the knife as it cuts behind the humerus, and grasp the posterior flap with the axillary artery, so as to prevent hæmorrhage from this vessel. An assistant holding the arm away from the body, so as to relax the deltoid somewhat, the knife, instead of being entered by a puncture, should make a small cross-cut, about an inch in extent, at the point at which transfixion is to be practised, so as to prevent that jagging of the integuments by the heel of the instrument which would otherwise occur. If the operation be on the right side, the surgeon stands before the patient, and the point of the knife should be entered about an

\* Hamilton's 'Military Surgery,' p. 455.

inch in front of the acromion (fig. 81), and being carried directly across the joint and capsule, should pass out at the posterior border of the axilla. If on the left side, the surgeon stands behind, and the point of the knife must be entered well behind the spine of the scapula, at the posterior border of the axilla, carried across the anterior aspect of the joint, and brought out to the inner side of the coracoid process. In either case, the large flap containing the deltoid muscle must then be cut with a sweep of the knife downwards, and, as soon as made, raised by another assistant. The heel of the knife is now to be laid on the head of the bone, the capsule of joint cut across, and the attachments of the muscles to the tuberosities divided. After

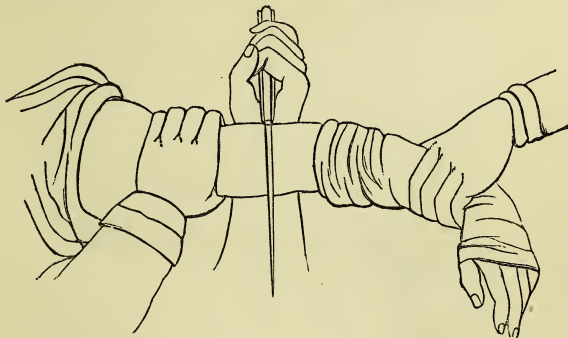


Fig. 82.

the head of the bone has been turned out of the glenoid cavity, the knife must be passed behind it and carried down for a distance of about three inches close to the bone at its inner side. The surgeon then cuts across the soft parts, so as to form the posterior flap. In doing this, the assistant to whom this part is entrusted must follow the knife with his hands, grasping firmly the whole thickness of the posterior flap, so as to compress the axillary artery and thus prevent the occurrence of hæmorrhage.”\*

Sir W. Fergusson recommends that a bistoury be used for these operations, instead of the more imposing-looking amputating knife ; but with such an

\* Erichsen’s ‘Science and Art of Surgery,’ vol. i., p. 42.

instrument the first flap on the left shoulder would be made by cutting from the skin towards the joint.

*Amputation of the Arm (Circular).*—"The arm being held out, and an assistant drawing up the skin, one circular incision is made through the integuments, which being forcibly retracted and detached from the deeper structures by a few touches of the point of the knife, and doubled back to the extent of an inch and three-quarters, or more, according to the thickness of arm, another is made down to the bone (fig. 82). These incisions should be made with slight divergences, so as to cut the skin and muscles rather longer in front and behind than at the sides."\*

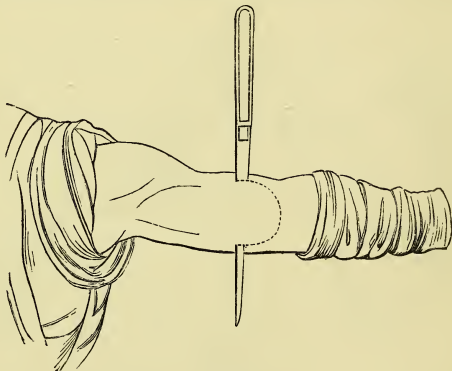


Fig. 83.

*Amputation above the Elbow.*—"The patient being seated, or laid on a table, with the elbow separated from the side, the humeral artery being secured by pressure, the arm should be transfixed three inches above the external condyle with a knife about seven inches in length, which should be carried obliquely downwards and forwards, so as to make from the inner surface a semi-lunar flap between two and three inches long; this should then be raised, when the soft parts on the opposite side should be divided in the same manner to a similar extent; the two flaps should now be drawn

\* Druitt's 'Surgeon's Vade Mecum,' p. 743.

upwards, the knife then carried round the bone, which should next be sawn through, and so the removal is completed. The flaps should then be brought into contact and kept in apposition with four or five stitches. Fig. 83 is intended to show the position of the knife after transfixion, and the dotted line the shape of the anterior or inner flap. The arm may either be straight, as exhibited in the figure, or slightly bent at the elbow, according to circumstances. The operation should be done in the lower third of the arm, if circumstances will permit; but the same instructions will answer for any part of its extent between the condyles of the humerus and its neck.”\*

*Amputation through the elbow-joint* can be performed by the circular method or by flaps. If by the circular, Hamilton recommends “that the incision should commence at least three inches below the joint. The integuments being retracted, the head of the radius should be sought, and the external lateral ligament severed; after which, having divided all the muscles, including the tendon of the biceps and the brachialis anticus, the coronoid process of the ulna will be easily made out; the anterior ligament and capsule may now be severed more completely, then the external lateral ligament. By moderate pressure upon the forearm the joint will now open sufficiently to admit the saw, if it is thought desirable to sever the olecranon process. It is a matter of indifference, perhaps, whether we dissect out the olecranon by cutting the triceps from behind, or divide it with the saw applied as we have directed.”†

*Flap Method.*—“This is performed by passing the knife through the muscles in front of the joint, and cutting upwards and forwards, so as to make a flap from the forearm. Then the operator makes a transverse incision from behind the joint. He next cuts through the external lateral ligament, and enters the joint between the head of the radius and external condyle, then divides the internal lateral ligament, and, lastly, saws through the olecranon, the apex of which, attached to the triceps, may be left in the stump, or may be afterwards dissected out.”‡

*Amputation of the Forearm.*—In performing this operation, as long a stump should be left as possible, so as to give the patient more power over any artificial limb that may be fitted to it. “The flaps should be about a couple of inches in length, and well rounded, the hand being placed in a mid-state between pronation and supination. The dorsal flap is best made by cutting from without inwards; the line of incision commencing just at the palmar aspect of the under part of the ulna, being carried forward for a little distance parallel to this bone, and then across the back of the arm in a slightly curved manner, until it reaches the palmar aspect of the radius; it must then pass along this until it reaches a point opposite to

\* ‘Practical Surgery,’ by Sir William Fergusson, p. 296.

† Hamilton’s ‘Military Surgery,’ p. 452.

‡ Druitt’s ‘Surgeon’s Vade Mecum,’ p. 744.

that at which it commenced, and the flap thus made must be dissected back. The palmar flap is next made by transfixion. As soon as it is cut, the bones are cleared by a couple of sweeps of the knife, and the interosseous membrane is divided; they are then sawn together. The vessels are cut long at the end and on each side of the palmar flap.”\*

Sir W. Fergusson recommends, in performing this operation, “to have the elbow slightly bent and the hand placed in a state of pronation (fig. 84).



Fig. 84.

A blade about six inches long should be passed from one side to the other, behind (or above) the bones; it should then be carried downwards, so as to come through the tendons and skin about an inch and a half lower down; the flap thus formed being raised, the knife should next be passed across close in front of the bones, and carried obliquely downwards, when a second flap, similar in size and shape to that already made, will be formed: both of these should now be drawn slightly upwards, and after all the

\* Erichsen's 'Science and Art of Surgery,' vol. i., p. 41.

textures close upon the bones have been divided, the saw should be applied close to the roots of the flaps, and the part separated.”\*

*Amputation at the Wrist (Flaps).*—“A semi-lunar incision is made across the back of the wrist, its extremities being at the styloid processes, and its centre reaching down as far as the second row of carpal bones. This flap being dissected up, the joint opened behind, and the lateral ligaments cut through, the knife, being placed between the carpus and bones of forearm, is made to cut out a flap from the anterior surface of the palm (fig. 85). The pisiform bone often causes, by its projection into the palm, a difficulty in cutting the anterior flap; if not dexterously avoided by the edge of the

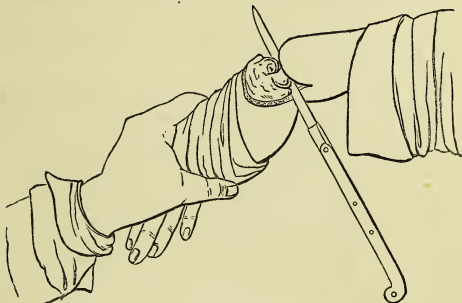


Fig. 85.

knife, it had better be taken at the joint with the soft parts of the flap, and afterwards dissected. The nerves and tendons must be shortened, the styloid processes removed, and the skin brought together by sutures.”†

*Amputation at the Wrist by External Flap.*—“Commencing just below the level of the articulation, while the hand is pronated, the surgeon makes a convex incision, beginning at the junction of the outer and middle thirds of the arm behind, reaching at its summit the middle of the dorsal surface of the first metacarpal, and terminating in front, just below the palmar surface of the joint, again at the junction of the outer and middle thirds of the breadth of the arm. This flap being raised, the wrist is disarticulated,

\* ‘Practical Surgery,’ by Sir W. Fergusson, p. 294.

† Druitt’s ‘Surgeon’s Vade Mecum,’ p. 746.



beginning at the radial side. A circular incision finishes the cutting of the skin.\*

*Amputation of one or more Metacarpal Bones.*—No rules can well be given for incision or flaps; they must just be obtained where and how they can best be got. A single dorsal incision over the bone will allow it to be dissected out of the hand.

*Amputation of Index or Little Finger.*—"The knife should be applied over the back and middle of the metacarpal bone, and carried downwards along the side and under-surface of the joint, and up again to where it was first entered, as represented by dark lines in fig. 86. After this the soft parts near the bone must be divided, and then the forceps may be used in such a manner as to cut the bone obliquely, so that there shall be no angular projection towards the skin."†

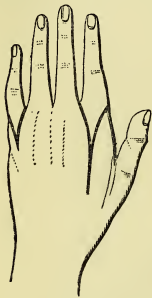


Fig. 86.

*Amputation of the metacarpal bone of the thumb* may be performed in many different ways. The method recommended by Erichsen is as follows:—"The mode of proceeding must vary according to the side operated upon. When the left thumb requires amputation, the point of a long narrow bistoury should be introduced well on the palmar aspect of the carpo-metacarpal articulation, carried over this, which it opens, and the dorsum of the hand as far as the web of the index finger; the point of the knife should then be pushed downwards through the ball of the thumb, transfixing this, and issuing where the incision commenced. It is next made to cut outwards, keeping

close to the metacarpal bone, which is readily twisted out, the remaining attachment being separated by a few touches of the knife. In amputating the right thumb, it will be necessary for the surgeon, if he adopt the method just described, either to use his left hand, or to cross his hands in an awkward manner. In order to avoid doing this, he may reverse the steps of the operation with advantage; first transfixing the ball, and making the anterior flap, then cutting over the dorsum, opening the joint, and turning out the bone."‡

"The metacarpal bone of the thumb may be removed through an incision on its radial margin, where the surgeon may avoid cutting either the extensor or flexor tendons. The distal extremity should first be detached from its connections, when the bone can be used as a lever whilst separating

\* 'Manual of the Operations of Surgery,' by J. Bell, F.R.C.S.E., p. 54.

† 'Practical Surgery,' by Sir W. Fergusson, p. 288.

‡ Erichsen's 'Science and Art of Surgery,' vol. i., p. 40.

it from the other parts. The radial artery will be endangered whilst cutting some of the fibres which bind the bone to the os trapezium.”\*

*Amputation of a whole Finger.*—“If the third or fourth digits require amputation, it should be performed as follows:—An assistant holds the hand, separating the fingers at each side of the one to be removed. The surgeon, holding the finger to be removed, enters the point of a long straight bistoury exactly above the metacarpo-phalangeal joint, and cuts from the prominence of the knuckle right into the angle of the web, then turning inwards there, cuts obliquely into the palm to a point nearly opposite the one at which he set out. He then repeats this incision on the other side, makes tense the ligaments, first at one side and then at the other, by drawing the finger to the opposite side, and cuts them. The tendons being cut, the finger is detached.”†

*Amputation through the Second Phalanx.*—“If the distal phalanx be so much crushed that a flap cannot be obtained, two short semi-lunar lateral flaps may be dissected from the sides of the second phalanx, which may then be divided by the bone-pliers at the spot required.”‡

*Amputation of a Distal Phalanx.*—“There is no choice as to a flap, the nail preventing an anterior one; so a flap long enough to fold over must be cut from the pulp of the finger in either of two ways. 1. Holding the fragment to be removed in the left hand, and bending the joint, the surgeon makes a transverse cut across the back of the finger, right into and through the joint, cutting a long palmar flap from within outwards as he withdraws the knife. 2. Making the long flap by transfixion, it may be held back by an assistant, and the joint cut into.”§

*Amputation at the Hip-joint.*—Numerous methods have been described for performing this operation. The following is *Lisfranc's double lateral flap* (fig. 87):—

“The patient must be laid upon his back with the tuberosities of the ischia projecting slightly beyond the edge of the bed, and the limb held in a position between abduction and adduction. Then having determined, by the anatomical rules laid down, the anterior and external side of the articulation, the operator, holding perpendicularly a long double-edged knife, introduces it at this point, with its lower edge looking downwards towards the great trochanter. As the point of the knife enters, it should be carried around the head of the femur on its outer side, whilst its handle is inclined

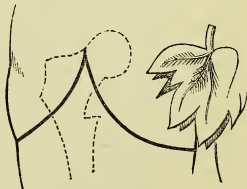


Fig. 87.

\* ‘Practical Surgery,’ by Sir W. Fergusson, p. 291.

† ‘A Manual of the Operations of Surgery,’ p. 49.

‡ Ibid., p. 49.

§ Ibid., p. 48.

upwards and outwards, and pushed steadily on in this direction, so that it perforates the integuments a few lines below the tuberosity of the ischium. While this is being done, an assistant grasps the tissues over the trochanter, and carries them outwards, in order to assist in the formation of the external flap, and the knife is carried downwards and outwards with a slightly sawing motion, around the great trochanter and along the femur, cutting out the flap from three to four inches in length. The first flap being thus made, the operator, grasping the tissues on the inside of the thigh and carrying them inwards, introduces the knife below the head of the femur, and on the inner side of its neck, holding it in a perpendicular position. As it enters, the point of the knife should pass round the neck of the femur, and come out at the lower angle of the wound already made, without coming in contact with the bones of the pelvis; it is then carried downwards along the femur, and avoiding the lesser trochanter, so as to make an internal flap of the same length as the external. The flaps being drawn aside by the assistants, and the arteries tied, the surgeon grasps the femur with his left hand, and holding the knife perpendicularly on the inner side of the head of the bone, cuts the capsular ligament, without attempting to penetrate the articulation. The joint being opened, the disarticulation is concluded by cutting the fibrous and muscular tissues which remain.”\*

*Guthrie recommends the oval method*, and describes it thus:—“The patient is to be laid on a low table, or other convenient thing, in a horizontal position; an assistant, standing behind and leaning over, compresses the external iliac artery becoming femoral, as it passes over the edge of the pubis. The surgeon, standing on the inside, commences his first incision some three or four inches directly below the anterior spinous process of the ilium, carries across the thigh through the integuments, inwards and backwards, in an oblique direction, at an equal distance from the tuberosity of the ischium to nearly opposite the spot where the incision commenced; the end of this incision is then to be carried upwards, with a gentle curve behind the trochanter, until it meets with the commencement of the first; the second incision being rather less than one-third the length of the first. The integuments, including the fascia, being retracted, the three gluteal muscles are to be cut through to the bone. The knife being then placed close to the retracted integuments, should be made to cut through everything on the anterior part and inside of the thigh. The femoral or other large artery should then be drawn out by a tenaculum or spring forceps, and tied. The capsular ligament being well opened, and the ligamentum teres divided, the knife should be passed behind the head of the bone thus dislocated, and made to cut its way out, care being taken not to have too large a quantity of muscle on the under part, or the integuments will not cover the wound, under which circumstance a sufficient portion of muscular

\* Hamilton's 'Military Surgery,' p. 477.

fibre must be cut away. The obturator, gluteal, and ischiatic arteries are not to be feared, being each readily compressed by a finger until they can be duly secured. The capsular ligament, and as much of the ligamentous edge of the acetabulum as can be readily cut off, should be removed. The nerves, if long, are to be cut short. The wound is then to be carefully cleansed, and brought together by three or more soft leaden sutures in a line from the spine of the ilium towards the tuberosity of the ischium. This mode of proceeding is more certain of making good flaps where integuments are scarce. Where the integument will admit of the anterior flap being made by the sharp-pointed puncturing knife dividing the parts after it has



Fig. 88.

been passed across from without inwards, there is no objection to this proceeding, and some prefer it.\* The outline of incision in Mr. Guthrie's method is represented in fig. 88.

*Sir William Fergusson recommends the following proceeding:—*"The table should be stout, of a convenient height, not so broad as to prevent the surgeon and assistants being in close contact with the patient, and a folded blanket, with a couple of pillows, should be on its upper surface. The patient's breech should be brought close to the margin of the table, and the sound limb should be fastened to one of its legs. An assistant should stand immediately behind the surgeon, whose chief duty will be to raise the first flap and compress the femoral artery; another should stand opposite to hold the pelvis steady, and assist in keeping the patient's body from slipping. A third may also be useful at the shoulders to aid in this, as,

\* Guthrie's 'Commentaries,' p. 65.

from so much of the body being beyond the table, and perhaps also from the mode of operating, there is a chance of the pelvis falling over the margin; a fourth should have the limb entrusted to his care, and he, with the other who has charge of the artery, should clearly understand the intended movements of the surgeon; and the immediate and satisfactory accomplishment of the operation depends much on the simultaneous movements of the whole three.

“The surgeon, standing on the outside of the limb, should insert the point of a long knife about midway between the anterior superior spinous process of the ilium and trochanter major, keeping it rather nearer the former

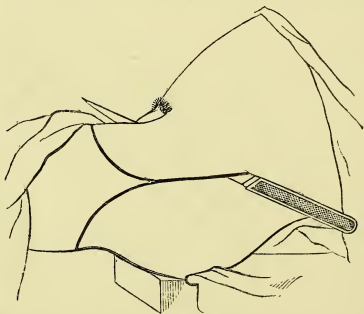


Fig. 89.

than the latter; he should then run it across the front of the neck of the bone, and put it through the skin on the opposite side (fig. 89), about two or three inches from the anus; next he should cut downwards and forwards, so as to make a flap from the anterior of the thigh, about five or six inches in length. When the blade is entered, the limb should be held up, and even slightly bent at the joint; the instrument will then pass along more readily than if all the textures were thrown on the stretch; moreover, there is greater certainty of passing it behind the main vessels, and even dividing some of the fibres, if not the whole of the iliacus internus and psoas muscles. As the knife is carried downwards, the assistant, who stands nearer the patient's trunk than does the operator, should slip his fingers into the wound and carry them across to grasp the femoral artery between them

and the thumb ; this he may do from the inside or outside at will, and with the right or left hand, as may be most convenient, the same grasp enabling him to raise the flap as soon as it is completed. The flap being raised, the point of the knife should then be struck against the head of the bone, so as to divide the anterior part of the capsular ligament and any textures in this situation which may not have been included in the flap. To facilitate this part of the operation, the knee should be forcibly depressed by the assistant who holds it ; the head of the bone will thus be caused to start out of its socket, and if the round ligament is not ruptured by the force, a slight touch with the edge of the knife will cause it to give way. At this period, depression being no longer required, the assistant should bring the head of the femur a little forward to allow the knife to be slipped over and behind it ; and when it is in this position, it should then be carried downwards and backwards, so as to form a flap somewhat longer than that in front, the last cut in the skin completing the separation of the limb.

“Delpech, Larrey, and others recommended ligature of the femoral artery as a preliminary step ; but it seems unnecessary, and the proceeding has been rarely resorted to.”\*

*Amputation of the thigh* may be performed by the circular method, by the lateral flap operation, by the antero-posterior flap operation, or flaps may be taken from any opposite aspects, or Teal’s method may be adopted.

The operation may be performed immediately above the knee, in the middle of the limb, or in its upper third. In the middle and upper thirds of the thigh, the antero-posterior flaps leave the best results, and give the best covering to the bone ; but amputation above the knee is best done by lateral flaps.

*Antero-posterior Flap Operation.*—“In ordinary cases the anterior flap may first be made, and posterior one subsequently fashioned by transfixion. If, however, the patient is very much emaciated, it is difficult to get a good cushion from the anterior part of the thigh in this way ; and it is consequently preferable to follow the plan recommended by Mr. Luke, of making the posterior flap first by transfixion, and the anterior one afterwards by cutting from without inwards. In some instances in which the tissues at the posterior part of the thigh are much diseased or injured, whilst those on the anterior aspect of the limb are sound, a very good stump may be fashioned by cutting a long square anterior flap by transfixion, and then cutting at one stroke of the knife through the soft parts at the posterior aspect of the limb, in a somewhat oblique direction, from below upward.

“If the patient be excessively muscular, and the amputation be a primary one, it is better to make skin-flaps and a circular incision through the subjacent soft parts.”†

\* ‘Practical Surgery,’ by Sir W. Fergusson, p. 448.

† ‘Science and Art of Surgery,’ by Erichsen, vol. i., p. 55.

*Amputation of Thigh, similar to that by Vermeal's Operation.*—“The surgeon, standing on the outside of the limb, should grasp the soft parts on the outer side of the thigh between the finger and thumb, and having drawn them, as it were, from the side of the bone, should pass the knife from before backwards, or rather from above downwards, as represented in fig. 90, and then cut downwards and outwards, so as to form a flap, the extremity of which is pointed out by the dotted line on the outer side. Next, the knife

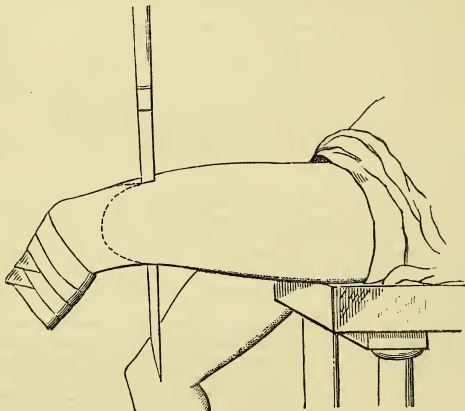


Fig. 90.

should a second time be introduced in front, and carried backwards or downwards in the line with its original course, but on the opposite side of the bone, when, by cutting again downwards and towards the surface, the inner flap is formed; both of them should then be drawn upwards with considerable force by the hands of an assistant, and an incision made round the bone, an inch or more higher than the place of transfixion; the saw should then be applied in the course of this last cut, and separation completed by division of the bone. In transfixing, the point of the knife should be thrust directly down to the femur, with which it should be kept in close contact as



it is carried round to the opposite surface. And this process will be greatly facilitated by grasping the limb as directed.\*

*Amputation through the knee-joint* may be performed with a long posterior and short anterior, or with a long anterior and short posterior flap.

*The operation with the long posterior and short anterior flap* may be readily performed in the following way:—"An incision is made directly across the knee-joint, above the centre of the patella. The skin flap thus formed is dissected back, and, the joint being opened above the patella, and the ligaments divided by a few touches of the knife, a long posterior flap is cut from the upper part of the calf of the leg, by passing the knife behind the tibia, and carrying it downwards for a suitable distance."

*The operation by means of a long anterior and a short posterior flap* is thus performed:—"A long square flap, rounded at the corners, is made by dissecting up the integuments and the patella from the front of the joint. The articulation is thus opened; the ligaments are then divided, and a short posterior flap formed by cutting from within outwards.

"The management of the patella is an important question. Erichsen thinks it is decidedly better to leave than to remove this bone; and to prevent it being drawn up on anterior part of the thigh, the flap should be turned up, and the tendinous insertion of the quadriceps divided. The cartilaginous surface of the femur in these amputations may be sawn off."†

*Amputation through the Condyles of the Femur (Syme's).*—"With an ordinary amputating knife, make a lunated incision from one condyle to the other across the front of the joint, on a level with the middle of the patella, divide the tissues down to the bones, and then draw the flap upwards, then cut the quadriceps extensor immediately above the patella. The point of the blade should then be pushed in at one end of the wound, thrust behind the femur, and made to appear at the other end; it should then be carried downwards, so as to make a flap from the calf of the leg, about six or eight inches in length, in proportion to the thickness of the limb; the flap should then be slightly retracted, and the knife carried round the bone a little above the condyles, to clear a way for the saw, which should be applied so as to leave the section as horizontal as possible."‡

*Carden's Amputation at the Condyles of the Femur.*—"The operator standing on the right side of the limb, seizes it between his left forefinger and thumb at the spot selected for the base of the flap, and enters the point of the knife close to his finger, bringing it round through the skin and fat below the patella to the spot pressed by his thumb; then turning the edge downwards at a right angle with the line of the limb, he passes it through the spot where it first entered, cutting outwards through everything behind the

\* 'Practical Surgery,' by Sir W. Fergusson, p. 439.

† Erichsen's 'Science and Art of Surgery,' p. 52.

‡ 'Manual of the Operations of Surgery,' by J. Bell, p. 87.

bone. The flap is then reflected, and the remainder of the soft parts divided straight down to the bone; the muscles are then slightly cleared upwards, and the saw is applied."

Fig. 91 represents outline of incision, and fig. 92 the stump.

Mr. Carden lays great stress on the following points:—"Whilst tying the popliteal artery in this situation, there is a tendency to secondary hæmorrhage from the vein, in consequence of its close proximity to the artery. This occurred in two cases, and on re-opening of the stumps the closure of the vein was found to be prevented by the stroke of the artery.

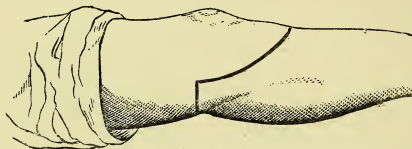


Fig. 91.

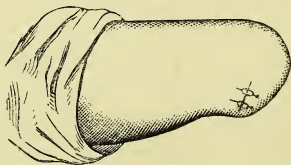


Fig. 92.

The vessel should be gently separated for an inch upwards. The dressing may be of the lightest and simplest kind, and it is of the greatest importance that they should be loosened and stump examined early."\*

*Amputation of the Leg, double flap upper fourth.*—"A stout bistoury, with a blade four or five inches long, and a broad saw, are the only cutting instruments required. The flaps are made of integuments only, by cutting from the surface without transfixion. The point of the knife is entered at the side, about two inches below the tibial tubercle, and carried across the front of the leg, describing an anterior curved flap rather longer than, and of the exact width of, the half diameter of the limb. This is dissected

\* 'British Medical Journal,' April, 1864, p. 416.

up close to the bones and deep fascia. A flap exactly similar is then made on the posterior aspect, and the integuments composing it are raised from the muscles. The latter, with the large vessels and nerves, are then divided transversely, direct to the bones. The bones are then equally sawn across.\*

*Oval Amputation through the Calf.*—"An oval incision is made in the direction shown in fig. 93, through skin and fat; these are thoroughly drawn back; the incision is carried upwards obliquely through the gastrocnemius to the bones, so as to make a posterior flap; this being well pulled up, the remaining soft parts around and between the bones are

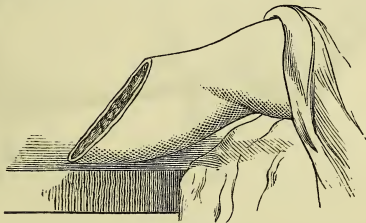


Fig. 93.

divided; lastly, the bones are sawn through. The integuments are brought together in a transverse line. The objection to this method is, that from retraction of the muscles in the posterior flap, the front edge of the cut tibia may be left bare, and become necrosed, or give rise to a tender stump.†

*Amputation of the Leg by single flap Operation, as practised by Sir W. Fergusson.*—"The heel of the instrument should be laid on the side of the leg farthest from the surgeon, and the blade should then be drawn across the front, cutting a semilunar flap of skin, until its point comes opposite to where the edge was first laid on; without raising the instrument, transfixion should next be made behind the bones (fig. 94), and the rest of the proceedings conducted as in other instances."‡

*Circular amputation of the leg* is only applicable to the calf.

*Disarticulation of the Foot at the Ankle-joint. (Syme's Amputation.)*—The foot being held at a right angle to the leg, the point of the knife is

\* Druitt's 'Surgeon's Vade Mecum,' p. 739.

† Ibid., p. 740.

‡ Fergusson's 'Practical Surgery,' p. 430.

introduced immediately below the malleolar projection of the fibula, rather nearer its posterior than anterior edge, and then carried across the bone to the inner side of the ankle, where it terminates at the point *exactly opposite* its commencement.

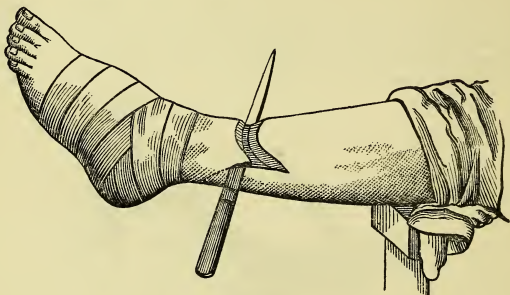


Fig. 94.

The extremities of the incision thus formed are then joined by another passing in front of the joint (fig. 95). The operator next proceeds to detach the flap from the bone, and for this purpose, having placed the fingers



Fig. 95.

of his left hand over the prominence of the *os calcis*, and inserted the point of his thumb between the edges of the plantar incision, guides the knife between the bone and the nail of the thumb, taking great care to cut parallel with the bone, and to avoid scoring or laceration of the integu-

ments. He then opens the joint in front, carries the knife outwards and downwards on each side of the astragalus, so as to divide the lateral ligaments, and thus completes the disarticulation. Lastly, the knife is carried round the extremities of the tibia and fibula, so as to afford room for applying the saw by means of which the articular projections are removed, together with a thin connecting slice of bone covered by cartilage. The vessels being then tied, and the edges of the wound stitched together, a piece of wet lint is applied lightly over the stump, without any bandage, so as to avoid the risk of undue pressure in the event of the cavity becoming distended with blood, which would be apt to occasion sloughing of the stump.\*

*Amputation through the Tarsus. (Chopart's Operation.)*—"In the first place, the articulation of the cuboid with the os calcis (which lies about midway between the external malleolus and the tuberosity of the fifth metatarsal bone), and that of the navicular with the astragalus (which will be found just behind the prominence of the navicular bone in front of the inner ankle), must be sought for, and a semilunar incision be made, across the dorsum, from one to the other. The flap of the skin being turned, the internal and dorsal ligaments that connect the navicular to the astragalus are to be divided with the point of the bistoury, recollecting the convex shape of the head of the latter bone. The ligaments connecting the os calcis and cuboid are next divided; and, lastly, a flap is to be procured from the sole of the foot."†

*Amputation of all the Metatarsal Bones. (Hey's operation, as described by himself.)*—"I made a mark across the upper part of the foot, to point out as exactly as I could the place where the metatarsal bones were joined to those of the tarsus. About half an inch from this mark, nearer the toes, I made a transverse incision through the integuments and muscles covering the metatarsal bones. From each extremity of this wound I made an incision (along the inner and outer side of the foot) to the toes. I removed all the toes at their junction with the metatarsal bones, and then separated the integuments and muscles forming the sole of the foot from the inferior part of the metatarsal bones, keeping the edge of my scalpel as near the bones as I could, that I might both expedite the operation and preserve as much muscular flesh in the flap as possible. I then separated with the scalpel the four smaller metatarsal bones at their junction with the tarsus, which was easily effected, as the joints lie in a straight line across the foot. The projecting part of the first cuneiform bone which supports the great toe I was obliged to divide with a saw."

To avoid the difficulties of disarticulation, Skey recommends cutting off the head of the second metatarsal with a pair of pliers. Baudens,

\* 'Principles of Surgery,' Syme, p. 166.

† Druitt's 'Surgeon's Vade Mecum,' p. 752.

Guérin, and others, approve of sawing all the bones across in the line desired.\*

*Removal of Metatarsal Bone of great Toe.*—"The point of a strong and broad bistoury should be entered on the dorsum of the foot over the interspace between the first and second metatarsal bones, as far back as possible; it should then be carried forwards upon the ball of the great toe, to a point opposite to the web between the toes, and thence made to sink into the sole of the foot in a line parallel with the outer margin of the bone; the flap thus formed should be dissected back, its plantar aspect being kept as thick and fleshy as possible. The surgeon next passes the knife between the first and second metatarsal bones, and cuts directly forwards through the centre of the angle between the great and the second toes. In doing this, care must be taken that the edge of the knife is not directed too much towards the metatarsal bone of the great toe, lest it hitch against one of the sesamoid bones. The surgeon next seizes the extremity of the toe, and, pressing it well inwards, passes the point of the bistoury deeply into the angle of the wound, where, by the division of some tendinous and ligamentous fibres that constitute the key of the joint, he opens the articulation, and detaches the bone by lightly touching its ligamentous attachments.

"When the bone is to be partially removed, the operation must be performed in the same way; the incisions, however, not being carried so far backwards."†

*Removal of Metatarsal bone of little Toe.*—"This is best done by entering the point of the knife just behind the tubercle of the bone, carrying it forwards and inwards in the line of its articulation with the cuboid, to the centre of the fourth digital interspace, and thence forwards to the web of the toe; the knife is next carried round the plantar surface of this, the incision being continued obliquely into that which has been made on the dorsum of the foot. The small flap thus formed is well dissected down, the knife passed round the under surface of the bone, and the joint opened by the toe being forcibly drawn outwards, and its ligamentous connection lightly divided.‡

*Amputation of Distal Phalanx of great Toe.*—When possible, a long flap should be made from the plantar surface, by laying the edge of the knife over the dorsal aspect of the joint, cutting through it, and turning the edge of the knife round close to the bone, so as to cut out a long flap from the ball of the toe.

*Amputation of a single lesser Toe, second, third, or fourth.*—"This operation is exactly on the same principle as that described for amputation of a whole finger, but it should be remembered that the metatarso-phalangeal

\* Bell's 'Manual of Operative Surgery,' p. 70.

† Erichsen's 'Science and Art of Surgery,' vol. i., p. 45.    ‡ Ibid., p. 48.

joint is more deeply situated in the soft parts than is the metacarpo-phalangeal ; and thus the commencement of the elliptical incision which is to surround the base of the toe must be proportionally higher up. On the other hand, as it is very important to avoid as much as possible any cicatrix in the sole of the foot, the plantar end of the incision need not be carried to a point exactly opposite the one from which it set out, but it will be sufficient if it reaches the groove between the toe and sole.”\*

*Teal's Operation (Amputation).*—This plan of operation Mr. Teal introduced “to procure a more useful stump, and in the hope of somewhat diminishing the mortality of the operation. It is proposed to amputate by a long and a short rectangular flap, the long flap folding over the end of the bone being formed of parts generally devoid of large blood-vessels and nerves, whilst those important structures are contained in the short flap. The size of the long flap is determined by the circumference of the limb

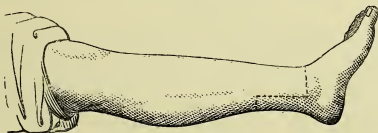


Fig. 96.

at the place of amputation, its length and its breadth being each equal to half the circumference. The long flap is therefore a perfect square (fig. 96), and is long enough to fall easily over the end of the bone. In selecting the structures for its formation, such parts must be taken as do not contain the larger blood-vessels and nerves. A flap so formed will be for the most part anterior in position as far as regards the general aspect of the body, but superior when the patient is in the recumbent position, as during the after-treatment. The short flap, containing the chief vessels and nerves, is in length one-fourth of the other. The flaps being formed, the bone sawn, and arteries tied, the long flap is folded over the end of the bone; each of its free angles is then fixed by sutures to the corresponding free angle of the short flap. One or two more sutures complete the transverse line of union of the flaps. At each side the short flap is united to the corresponding portion of the long one by a point of suture, and one suture more unites the reflected portion of the long flap to its unreflected portion. Thus, the transverse line of union is bounded at each end by a short lateral line at right angles to it.”† (Fig. 97).

\* Bell's 'Manual of Surgical Operations,' p. 66.

† Teale on 'Amputation,' p. 8.



*Pirogoff's Amputation.*—"The operation is performed in the following way:—An incision is carried across the sole of the foot from one malleolus to the other. This incision must not be made directly transverse to the foot, but should incline forwards obliquely, so that the centre of the incision in the sole may be at least an inch in front of a line drawn across from the tip of one malleolus to the other. The flap thus traced is dissected for

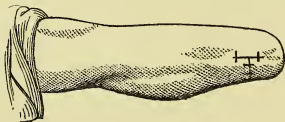


Fig. 97.

about two lines. Disarticulation of the astragalus is then effected in the usual way by an incision across the front of the foot. A narrow amputating or a Butcher's saw is now applied to the upper and back part of the os calcis behind the astragalus, and the bone is cut obliquely downwards and well forwards; the malleoli are then removed, and a thin slice of the tibia, with the articular cartilage, taken off. The opposed osseous surfaces must then be accurately adjusted, the moveable flap well supported by a broad strip of plaster, and the limb laid on the outer side, with the knee placed so as to take off the tension of the tendo-Achillis."\*

This amputation has been objected to by many on account of the liability to recurrence of disease in the portion of the os calcis. It has certainly not been successful with army surgeons. Mr. Bryant looks upon the operation "as a very excellent one; it ought always to be preferred to Syme's when the os calcis is sound. Should the bone be found to be bad at the time of the operation, it must be taken away, the operation being made into a Syme's; but when the bone is good, it appears to be a grave error to take away what makes so good a point of support to the body."†

\* Erichsen's 'Science and Art of Surgery,' vol. i., p. 49.

† Bryant's 'Practice of Surgery,' p. 1064.

## EXCISION.

*Excision of the Head of the Humerus.*—This operation may be performed in several different ways: they consist of a single vertical incision, and its modifications of **Γ** and **T** shaped ones; also the flap operation of **U** shape. Larrey recommended the single long incision, extending in a line from the acromion, through the fibres of the deltoid, for about four or five inches. This operation is thus described:—"The patient lies on the side opposite to the affected or injured limb. The surgeon then enters the knife a little to the outside of the coracoid process, and carries it downwards and outwards for about five inches, cutting down to the bone. He then cuts across the capsule any adhesions that may exist, and the attachments of the muscles inserted into the tubercles of the humerus. The assistant, who has charge of the limb, facilitates this part of the operation by drawing it well across the chest, and pushing the head of the bone backwards and tilting it outwards, so as to cause it to project. The surgeon, carefully clearing it all round, has the soft parts well retracted, and then, taking the limb in his own hands, pushes the head of the bone out of the wound, so as to admit of the easy application of the saw by which it is removed."\*

*Mr. Hamilton remarks on this subject*:—"In gun-shot or other comminuted fractures of the head of the humerus, demanding ex-section, the surgeon will find it necessary, in general, to make for himself a larger opening than the single longitudinal incision will furnish. It will be necessary, then, to make an oval or **V**-shaped incision, so as to form a flap, having its base upwards."†

*Guthrie considers* that in doing this operation, in cases of some standing, he prefers a short crescentic flap by an incision across the anterior part of the shoulder, as in the operation of amputation, which on being turned up leaves the joint exposed. The edge of the knife being applied to the head of the bone in a line below, but immediately under the acromion process, divides the capsular ligament, and with it the long tendon of the biceps, on which the arm drops from the socket or glenoid cavity, and allows the finger to be introduced, when the three muscles inserted into the great tuberosity may be cut through, and the subscapularis, inserted into the small tuberosity, will also be divided.‡

*Sir William Fergusson is of opinion* that the surgeon should not limit

\* Erichsen's 'Science and Art of Surgery,' vol. ii., p. 184.



† Hamilton's 'Military Surgery,' p. 503.

‡ Guthrie's 'Commentaries,' p. 118.


himself to one mode of procedure, but should rather, trusting to his anatomical and manipulative skill, adapt his measures to the peculiarities of the case. He recommends the adoption of a plan similar to that originally followed by Morel. The patient being seated or laid on his back, an incision should be made with a strong bistoury, commencing opposite the coracoid process, and ending about an inch behind and below the root of the acromion. It should be semilunar in shape. The extreme convexity should be about four inches under the acromion, and thus the greater portion of the deltoid will be included in this flap. The skin and deltoid being divided, the flap should be drawn upwards, a few touches of the knife being sufficient to separate the loose connections of this muscle. A bold incision should next be made through the tendons attached to the tuberosities of the humerus, dividing them and the capsule at the same time to such an extent as to permit the head of the bone being turned out by a slight twist. This part should then be laid hold of with the lion forceps by the surgeon or an assistant, and held steady whilst the saw is used to separate as much as may be necessary. If the operation is done for a shattered bone, its head cannot be thrust out like the end of a lever, as thus directed; and therefore the surgeon must make use of his fingers or any convenient hook or forceps to enable him to raise the fragments.\*

*Excision of the Clavicle.*—It may be necessary to remove this bone wholly or partially, and to perform the operation it is necessary to make a free incision along its whole length; it should then be disarticulated or sawn through at its acromial articulation and dissected out from without inwards, the sternal end being forcibly twisted outwards and all attachments carefully cut, great care being paid to the numerous small veins in this position.

*Excision of the Scapula (Syme's operation).*—Make an incision from the acromion process transversely to the posterior edge of the scapula, and another from the centre of this one directly downwards to the lower angle of the bone. The flaps formed being reflected back, separate the scapular attachment of the deltoid, and divide the connections of the acromial extremity of the clavicle. The division of subscapular artery will cause a great gush of blood, but it should be caught and secured without delay. The joint and around the glenoid cavity should next be cut into, and finger hooked under the coracoid process, so as to facilitate the division of its muscular and ligamentous attachments; and then, by pulling back the bone with great force by the left hand, the remaining attachments should be divided with rapid sweeps of the knife.

*Excision of the Elbow-joint* may be performed in three different ways—by a simple longitudinal incision, or by the  or . The longitudinal is

\* Fergusson's 'Practical Surgery,' p. 274.

the most simple ; but if it does not give sufficient room for clearing the bones, it may be formed into the  by a transverse incision directly across the end of the olecranon to the outward side of the joint.

Should the perpendicular incision be selected, it must be of sufficient length to allow of the sides being well apart. The bones should be fairly exposed and cleared to the inner side of the joint. In carrying the incision in this direction, Erichsen recommends that "the edge of the knife should always be kept against the bones, and their sinuosities closely followed, so that the ulnar nerve, being dissected out from behind the inner condyle, may escape injury. If the incision be properly planned, and the knife kept in contact with the bone, the nerve ought not to be exposed during the operation, more particularly as it is usually imbedded in a quantity of plastic tissue. When the posterior part of the joint has been laid bare in this way, the knife should be carried round the tip of the olecranon, and the process removed with cutting pliers. By forcibly bending the joint, pushing the forearm upwards, and lightly touching the ligaments with the point of the knife, the interior of the articulation will be fully exposed. By means of a small narrow saw the articular end of the humerus is separated from the rest of the bone ; the upper end of the ulna and the head of the radius may either be removed in the same way or by cutting pliers."

After the operation, the limb should be laid upon pillows nearly in the extended position, so that the cut portions of bone may be closely approximated to one another ; or Esmarch's splint may be applied, which has already been described (fig. 76).

*Excision of the Wrist.*—This operation is not in much favour with military surgeons. It may, however, be performed in several different ways. In disease, the presence of sinuses on the surface may be taken advantage of and followed up, giving sufficient opening between the extensor tendons and the bones.

Sir W. Ferguson recommends that incisions be made chiefly behind or at the sides, the parts in front being too important to be interfered with. He is of opinion that the operation may be most efficiently performed, and with the best prospects of a satisfactory result, by making a single incision along the ulnar side of the joint.\*

*Excision of the Carpal Ends of the Bones of the Forearm.*—Mr. Skey recommends the following operation : "The joint is exposed on the dorsal surface by two lateral incisions of two inches in length, united by a transverse line made below the projecting bone. The flaps being raised, the tendons are exposed, and should be separated from the radius by a knife passed underneath them in forcible extension of the hand backwards. Along this line the fine blade of a metacarpal saw may be readily passed,

\* Ferguson's 'Practical Surgery,' pp. 263, 264.

which, being jointed at the point, can be fixed to its back after passing across the tendon. The blade of a knife passed half an inch under the radial artery will protect it from injury.\*

*Professor Lister has adopted a method for excision of the wrist which has given satisfactory results, and which Mr. T. Holmes describes as follows:—*“An incision is made commencing in front over the second metacarpal bone, internal to the tendon of the extensor secundi internodii pollicis, and running along the back of the carpus, internal to the same tendon, as high as to the base of the styloid process of the radius. The soft parts, including the extensor secundi internodii, and the radial artery, being cautiously detached from the bones external to this incision, and the tendons of the radial extensors of the wrist being also severed from their attachments, the external bones of the carpus will be exposed. When this has been done sufficiently, the next step is to sever the trapezium from the other bones with cutting pliers, in order to facilitate the removal of the latter, which should be done as freely as is found convenient. The operator now turns to the ulnar side of the incision, and cleans the carpal and metacarpal bones as much as can be done easily. The ulnar incision is now made. It should be very free, extending from about two inches above the styloid process down to the middle of the fifth metacarpal bone, and lying near the anterior edge of the ulna. The dorsal line of this incision is then raised, along with the tendon of the extensor carpi ulnaris, which should not be isolated from the skin, and should be cut as near its insertion as possible. Then the common extensor tendons should be raised, and the whole of the posterior aspect of carpus denuded, until the two wounds communicate quite freely together; but the radius is not as yet cleaned. The next step is to clean the anterior aspect of the ulna and carpus, in doing which the pisiform bone and the hooked process of the unciform are severed from the rest of the carpus, the former with the knife, the latter with the cutting pliers. In cleaning the anterior aspect of the carpus, care must be taken not to go so far forwards as to endanger the deep palmar arch. Now, the ligaments of the internal carpal bones being sufficiently divided, they are to be removed with blunt bone forceps. Next the end of the ulna is made to protrude from the incision, and is sawn off, as low down as is consistent with its condition, but in any case above its radial articulation. The end of the radius is then cleaned sufficiently to allow of its being protruded and removed. If this can be done without disturbing the tendons from their grooves, it is far better. The operator next attends to the metacarpal bones, which are pushed out from one or other incision and cut off with the pliers so as to remove the whole of their cartilage-covered portions. The trapezium bone, which was left in the early stage of the operation, is now carefully dissected out, so as to avoid any injury to the tendon of

\* Skey's 'Operative Surgery,' p. 392.

the flexor carpi radialis or to the radial artery, and the articular surface of the first metacarpal bone is then exposed and removed. Lastly, the cartilaginous portion of the pisiform bone is taken away; but the nonarticular part is left behind unless it is diseased, in which case it should be removed entire. The same remark applies to the hooked process of the unciform.

"In order to ensure motion, particularly in the fingers, passive movements should be performed from a very early period after the operation. For this purpose, Mr. Lister places the limb on a splint with the palm of the hand raised by a large wedge of cork, fixed below it; so that the joints of the fingers can be moved without taking the limb off the apparatus"\* (fig. 98). See Esmarch's splint for excision of the wrist (fig. 77).

*Excision of the Hip.*—This operation may be performed by incisions of such shapes as may suit the surgeon's convenience for removal of the damaged bone; and in the event of the injury being from a gun-shot, there will

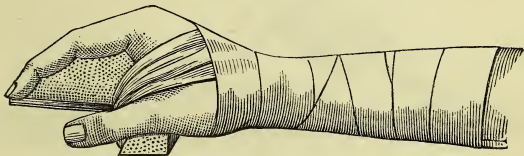


Fig. 98.

be an open wound which may be extended. There are, however, certain methods laid down by different authorities. Professor Gross prefers a semilunar flap of the gluteal muscles with the convexity downwards. This plan of incision, he considers, has the advantage, not only of allowing free access to the joint, but also of affording a ready outlet for the discharges. The superior extremity of the femur being thus exposed, is thrust out of the opening by carrying the limb across the sound one, rotating it inwards, and then pushing it up, when it is to be divided by means of a narrow saw. The great trochanter, however sound, should always be included in the operation, otherwise it will be sure to interfere more or less seriously with the healing process by projecting into the wound, and obstructing discharge.†

Mr. Skey describes two methods for excision of the head of the femur: the anterior and posterior. The former may be here described, the latter differing but little from others. The situation of the femoral artery being

\* Holmes's 'System of Surgery,' vol. v., p. 631.

† Gross's 'System of Surgery,' vol. ii., p. 1102.



marked in ink by an external line, a straight incision is made from about an inch below the trochanter major, along the line of the neck towards the acetabulum, stopping short of the nerves by at least half an inch. The neck being bared, and capsule opened, the operator will be able to ascertain the extent to which he can command the part to be removed. If necessary, a second incision may be made backwards across the neck of the bone. Mr. Skey gives preference to the posterior operation, which is safer and easier of execution.\*

Sir William Fergusson remarks on this operation: "Like resection of the head of the humerus, many different methods of exposing the upper end of the femur have been recommended. He holds the opinion that a knowledge of anatomy will best enable the surgeon to suit the proceeding to the peculiar features of each case. It would be folly to make a larger wound than is

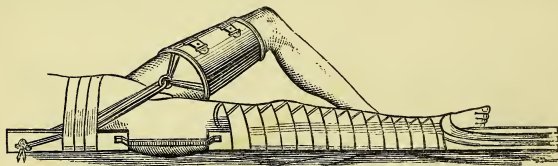


Fig. 99.

required for the due performance of the operation; and as long as the operator limits himself—in front, so as not to meddle with the branches of the crural nerve, or endanger the femoral arteries; and behind, so as to protect the sacro-sciatic nerve—it seems to him of little consequence what lines are cut on the surface. A straight one will, he believes, answer in general, but, with the views inculcated, it matters not what shape the flaps may be."

Many splints have been designed for the after-treatment of excision of the head of the femur. For permanent hospitals, Mr. Sayer's splint (wire breeches†) is perhaps the best; but for field hospitals, where appliances may have to be extemporised, fig. 99, which is similar to Mr. Erichsen's appliance, seems well adapted, and can be easily made. To secure quietude, a certain amount of extending force, and straightening the limb should be the surgeon's aim.

Sir W. Fergusson recommends that the extension should be made from

\* Skey's 'Operative Surgery,' p. 394.

† 'British Medical Journal,' July, 1871.



the opposite thigh, round the upper part of which a socket is fixed, to which the band is attached. The splint being bracketed, dressings can be applied with ease, and extension made by means of a weight.

*Excision of the Knee.*—In excising the knee-joint for gun-shot injuries, the army surgeon may be able to take advantage of a wound already existing in forming his incisions, instead of adhering to any plan of incision as laid down in civil practice. He has, however, many plans to select from : such as the straight transverse incision ; two parallel incisions, one on each side of the patella ; an **H** shaped incision ; a horse-shoe incision ; or, as Mr. P. Watson recommends, “a semilunar incision, raising a long flap from the anterior surface of the articulation.”\*

Mr. Holmes describes an operation which appears to the writer to have many advantages ; it is as follows :—“An incision should be made from the back part of one condyle to the back part of the other, passing across the front of the limb below the patella, and slightly convex downwards. It is seldom necessary to make any other incision in the skin ; but if there is much thickening about the soft parts, perpendicular incisions may be made at the ends of this, so as to form the **H** shaped incision, which used always to be employed in this operation. The ligamentum patella is to be divided in the first incision ; then the soft parts are to be thrown back from the patella and the end of the femur, and the patella is to be removed. The joint is now to be freely opened by cutting at the sides of the condyles, so as to sever completely both lateral ligaments ; and then the knife is to be carried round the posterior surface of the end of the femur, care being taken in doing this to thrust the femur out of the wound as much as possible, by an assistant forcibly flexing the limb, and to keep the edge of the knife directed towards the bone, and guided by the finger, so as to avoid the popliteal artery, which here is separated from the bone only by some fat and loose tissue ; and in sawing the bone, it may be advisable, if the femur have not been very completely cleaned, not to pass the saw entirely through the osseous tissue, but rather to break than cut the outer lamella at the back by using the saw as a lever. The end of the femur having been removed, the head of the tibia is to be cleaned and sawn horizontally, care being taken in young persons to keep close below the cartilaginous surface, so that the epiphysial line be not interfered with.

“In cases where there has been no dislocation, nor much alteration in the shape of the bones from previous disease, there is now usually no impediment to placing the limb in the straight position, with the bone in accurate adjustment. Otherwise they must be adjusted by taking off successive pieces from the end of the femur or tibia (if possible without going beyond

\* Watson on ‘Excision of the Knee-joint,’ p. 74.

the epiphysis); and in cases of old dislocation it is often necessary to sever some of the hamstring tendons.

"The parts should, in all cases, be adjusted in perfect position upon a splint, and the bandage firmly applied before the patient is moved or allowed to recover from the chloroform. If the femur appears at all prominent, a stout splint should be applied in front in order to counteract the tendency of the leg to gravitate backwards (which is also assisted by the action of the flexor tendons); and it is at any rate a useful precaution to apply a long side splint to the outer side of the limb, which can be discarded after the first few days, if it appears superfluous." Mr. Holmes has found much comfort to the patient from suspending the whole apparatus in a "Salter's swing." He uses splints which are interrupted and bracketed with iron at the seat of operation, so as to give access to the wound.\*

Numerous splints and plans of dressing have been designed for the after-treatment of excision of the knee. Mr. Butcher recommends a box splint; though inferior to apparatus now in use; this surgeon has turned

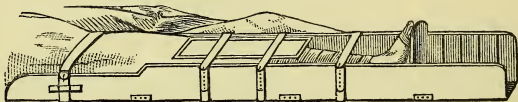


Fig. 100.

out many good cases with it. "It consists of two side splints, the outer one extending from the axilla to below the foot, the inner from the groin to below the foot and attached to a back piece. The sides are on hinges, so as to admit of letting down for dressing" (fig. 100).† This splint has been objected to on account of its being of wood, and absorbing the discharges; it is also very cumbersome, and cannot be swung; and in order to get at the sides of the wound, a portion, if not the entire retentive apparatus, must be undone.‡ However, being easily constructed, it appears well adapted for active service.

Mr. P. Watson has designed a splint for excision of the knee, which has received wide reputation. "It consists of two parts—1. A suspension-rod, made of iron, about the size of No. 5 of trade wire gauge; 2. A modelled Gooch splint, long enough to extend from tuberosity of the ischium to beyond the heel.

\* Holmes's 'System of Surgery,' vol. v., p. 699.

† Butcher's 'Operative and Conservative Surgery,' p. 141.

‡ Swain on 'Injuries and Disease of the Knee-joint,' p. 81.

"The suspension-rod extends from the groin to the extremities of the toes, and is bent to the outline of the limb, departing from it only in the situation of the excision, where it forms a bow or arch. To the upper surface of the rod are attached one or more hooks by which the suspension is effected (fig. 101).

"The Gooch splint should not be made too wide, and should certainly not surround the thigh and leg to more than two-thirds of their circumference. It should be scooped away laterally, at a part corresponding to the site of

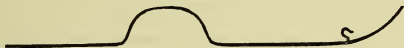


Fig. 101.



Fig. 102.—Posterior "Gooch" splint of ordinary form.

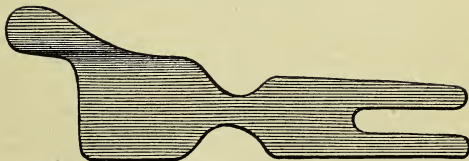


Fig. 103.—Alternative form of "Gooch" splint, the rounded part above adapted to the os innominatum, and secured by means of strips of adhesive plaster.

the excision, and should have an aperture cut corresponding to the tendo-Achillis and heel (figs. 102, 103). The inferior extremity of the splint is thus of a horse-shoe or stirrup shape, and admits of the ankle and foot being supported by the lateral horns of the splint, as they fold on each side of the malleoli, without the risk of inordinate pressure being made upon the

tuberosity of the os calcis. In application, the limb is first laid and carefully adjusted upon the posterior splint, which should preliminarily be padded with lint, and covered with gutta-percha tissue or hot paraffine, in the situation which corresponds to the site of operation. The iron rod is then placed in front, and folded lint laid between it and the limb at the groin (where the rod terminates above), at the upper part of the tibia, and at the bend of the ankle. These two parts of the apparatus are then retained in contact with the limb by means of an open-wove roller bandage applied from the toes upwards, the site of the incision alone being left uncovered. The whole is then rendered immovable by means either of plaster of Paris applied by the hand, of a consistence like thick cream, or of paraffine, which, having been rendered temporarily liquid by heat, is applied by a large painter's brush. When the application has solidified, the patient may be removed to bed, and the limb suspended from Salter's swinging cradle, or from the roof-bar of the common iron-wire cradle employed to support the weight of the bedclothes."\*

Mr. Butcher performs the operation with the H incision, and recommends that the perpendicular strokes be placed well back, so as to allow all fluids and discharges to drain off; and adds that they are far more effective and safer than any opening made in the popliteal space. The patella should be taken away in all cases, whether diseased or not. All bleeding vessels should be tied, or any that have sprung and retracted should be drawn out and secured. While the patient is yet on the operating-table, the limb should be placed in the horizontal position, either by gentle and steady traction, combined with pressure of the cut surfaces of the bones backwards, or, if necessary, the division of the hamstring tendons.

During the adjustment of the bones, great caution should be exercised that their surface be throughout their extent in contact, and that no soft parts intervene. The limb should not be disturbed for several days. In cases where large abscesses form in the vicinity of the excised joint, or up along the thigh, Chassaignac's drainage tubes may be used with the best possible hopes of success. The free administration of stimulants is imperatively demanded in all cases of excision, regulated to a certain extent by age, sex, temperament, and habit.†

*Excision of the Ankle.*—For removal of the entire joint Mr. Handcock devised the following method: "The foot is first laid on its side, and an incision is made over the lower three inches of the posterior edge of the fibula. When it has reached the lower end of the malleolus, it forms an angle, and runs downwards and forwards to within about half an inch of

\* 'Excision of the Knee-joint,' by P. Heron Watson, M.D., pp. 18, 19

† Butcher's 'Operative and Conservative Surgery,' p. 163, 169.

the base of the outer metatarsal bone. The angular flap is reflected forwards; the fibula, about two inches above the malleolus, is sufficiently cleared of soft parts to allow cutting forceps to be placed over it; and the bone is then nipped in two and carefully dissected out, leaving the peroneus longus and brevis tendon uncut. The foot is now to be turned over. A similar incision is made on the inner side, the portion on the foot terminating over the projection of the inner cuneiform bone. The flap is to be turned back, and the sheaths of the flexor digitorum and posterior tibial tendons exposed, the knife being kept close to the bone, avoiding the artery and nerve. The internal lateral ligament is then to be severed carefully close to the bone; and now the foot is twisted outwards, and the astragalus and tibia will present at the inner wound. A narrow-bladed saw, put in between the tendons into the inner wound, projects through the outer. The lower end of the tibia, then the top of the astragalus, may be sawn off in a proper direction. The only vessel that may require tying is one of the lower branches of the peroneal artery. The wound may be closed with sutures, except that part opposite the breach of osseous matter; the leg and foot placed on a splint with foot-board, and cold water applied."\*

*Mr. Guthrie recommends the following method for excision of the ankle: "Begin the incision behind the external malleolus, an inch and a half above its lower extremity, and carry it downwards and then forwards across the front of the ankle-joint (fig. 104), then under the internal malleolus and upwards, close behind the process, the extent of an inch and a half; this incision should merely divide the skin, and should not, on any account, wound the subjacent parts. Raise the flap thus made, and, placing the leg on its inside, detach and turn aside the peronei tendons from the groove behind the external malleolus. Cut through the external lateral ligaments of the ankle-joint, keeping the knife close to the end of the fibula; then with the large bone scissors, or nippers, cut through the fibula*



Fig. 104.

\* Holmes's 'System of Surgery,' vol. v., p. 712.

from one-half to three-quarters of an inch above its junction with the tibia, and, after dividing the ligamentous fibres connecting the two bones, remove the malleolus externus. Turn the leg on to its outer side, and cut through the internal lateral ligament close to the tibia, to avoid wounding the posterior tibial artery; this will allow the foot to be dislocated outwards, and the lower end of the tibia to be brought well out through the wound. An assistant keeping the foot and tendons out of the way, the lower end of the tibia is to be removed with a fine saw to the same extent as the fibula, or as high as the injury or disease requires. The articulating surface, or injured part of the astragalus, is then to be removed, after which the foot is to be returned to its proper position, and the cut surfaces of the tibia and astragalus brought into close approximation, and so kept by suture, strapping, and bandage. The limb is to be placed on an outside leg-splint, having a foot-piece to it.”\*

*Excision of the Os Calcis.*—“The patient lying on his face, a horseshoe incision is carried from a little in front of the calcaneo cuboid articulation round the heel, along the side of the foot, to a corresponding point on the opposite side. The elliptic flap thus formed is dissected up, the knife being carried close to the bone, and the whole under-surface of the os calcis exposed. A perpendicular incision, about two inches in length, is then made behind the heel, through the tendo-Achillis, in the mid-line and into the horizontal one. The tendon is then detached from its insertion and the two lateral flaps are dissected up, the knife being kept close to the bones, from which the soft parts are well cleared. The blade is then carried over the upper and posterior part of the os calcis, the articulation is opened, the interosseous ligaments are divided, and then, by a few touches with the point, the bone is detached from its connection with the cuboid. This bone, together with the astragalus, must then be examined; and if any disease be met with, the gouge should be applied.”†

*Excision of the Astragalus.*—“A curved incision should be made from one malleolus to the other, something like that made at the beginning of Syme’s amputation. The ankle-joint is then to be laid freely open, and the whole upper part of the diseased bone exposed. Then the ligaments connecting it to the scaphoid are to be severed, and the bone is to be levered up, when the interosseous ligament connecting it with the os calcis will, if entire, be felt, and can be readily divided. All that is then necessary to complete the operation is to clean the back part of the bone, which should be done with care, in order to avoid injury to the tendons and vessels which lie near it.

“The bone might also, no doubt, be removed by two lateral incisions similar to those used in excision of the ankle. This would avoid the injury

\* Guthrie’s ‘Commentaries,’ p. 91.

† Erichsen’s ‘Science and Art of Surgery,’ vol. ii., p. 207.

to the tendons and vessels incidental to the above method; but would be more laborious.\*

*Excision of other Tarsal Bones.*—"No formal directions are required for excising the other *tarsal bones*. The soft parts are to be thrown aside by crucial incisions, radiating from the sinuses which lead to the diseased bone, and the latter removed; care being taken, in all cases where it is possible, to excise the whole bone with the articulating surface." †

Professor Esmarch has designed a splint for the after-treatment of excision or resection of the ankle-joint; he found the great utility of such an apparatus for resection of the elbow-joint, and in consequence applied it to the ankle.

It consists of a strong piece of iron wire placed in front of the limb, extending from the toes to the groin, and bent at convenient angles to suit the front of the ankle and the knee, taking care that an arch is formed with it immediately above the seat of operation. Hooks should be formed

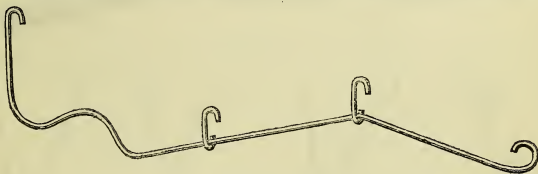


Fig. 105.

with the wire at either end, and two or three loose ones attached for the purpose of suspension (fig. 105). Underneath the limb should be placed a wooden splint, hollowed out and cut to an angle to correspond with the bend of the knee. Firmly secured to this is a foot-board, placed at right angles, which gives support to the foot, and forms a base for the plaster of Paris bandage (fig. 106).

In using the apparatus the wooden splint should be most carefully cushioned and applied, especially about the heel and foot, where any undue pressure may be attended by most serious consequences. The plaster of Paris bandage should then be applied in the usual manner, an opening being left at the seat of the wound for the purpose of applying dressings. Fig. 107 represents the splint applied and suspended.

Professor Esmarch says he has applied this apparatus in cases of resection of the ankle-joint for six or seven weeks, and that the patients have

\* Holmes's 'System of Surgery,' vol. v., p. 721.

† Ibid., p. 722.



never once had to complain of aches or pains, and that the advantages of these suspension splints are so great that he recommends them most earnestly for war service, as well as in time of peace.

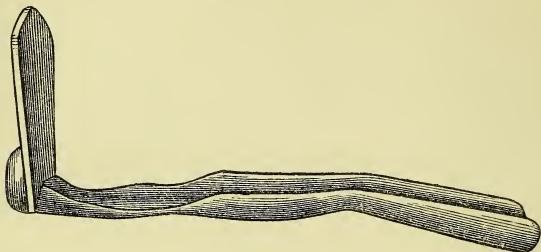


Fig. 106.

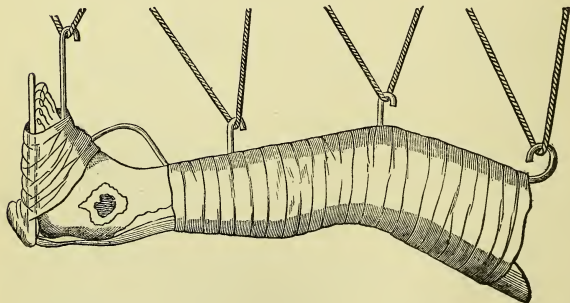


Fig. 107.\*

*Excision of Shafts of Long Bones.*—This operation may be partial, or it may be necessary to remove the whole bone.

As far as practicable, the subperiosteal operation should be performed.

\* Illustration copied from Esmarch's work on 'Bandaging,' p. 133.

An incision sufficiently long to admit of the working of the chain-saw should be made along the superficial aspect of the bone, when the periosteum must be detached with the handle of the scalpel, raspatory, or chisel recommended by M. Ollier, or other instruments suited for that purpose. A chain-saw may then be passed under the bone, the shaft divided, and the separated portion, being seized with a strong forceps, carefully detached.

*The subperiosteal operation for excisions and resections* has been recommended by many in consequence of the bone being reproduced to some extent, and tendons and muscles detached entire from the bone. It, however, has its disadvantage in being tedious; the periosteum, too, is liable to slough. It is doubtful if the reproduction of bone is a benefit in resection of joints at least, and it is frequently difficult to remove the diseased bone without detaching the periosteum from the healthy.

*Excision of the Eye.*—"When the eyeball has to be excised, it may be done thus:—The patient should be laid on the table with the face uppermost, and then, with a scalpel or bistoury, an incision should be made from the external commissure, half an inch beyond the margin of the orbit, when the eyelids may be more completely opened by an assistant, especially if the skin be detached from the bone above and below this wound; next, the organ should be seized with a forceps" (with hooked ends to the blades), "and then the point of the knife should be carried between the eyelids and the ball, so as to divide the conjunctiva; when, by carrying it deeper, and moving the organ from side to side with the instrument held in the left hand, the removal may be completed by dividing the muscles, optic nerve, and other textures. It will seldom happen that there is a difficulty or trouble in this proceeding; and the hæmorrhage will probably be easily commanded by stuffing the orbit after the operation with charpie or lint. Afterwards, caution must be taken to avert or subdue any high degree of inflammation, which, as may be readily perceived, must be more hazardous here than in many other regions.

If the forceps, as above mentioned, "be not at hand, a single or double hook will answer the purpose, or a thread may be carried with a common surgical needle through the ball, by which the operator can move the part at will."\*

\* 'A System of Practical Surgery,' by Sir W. Fergusson, p. 472.

## AFFECTIONS OF STUMPS.

*Affections of stumps* may be divided into primary and secondary.

*The primary* consist in hæmorrhage, spasm of the muscles, excessive pain, undue inflammation, osteo-myelitis, and inordinate retraction of the soft parts exposing bone.

*The secondary* consist in necrosis, neuralgia, strumous degeneration, fatty degeneration, aneurismal enlargement of vessels, exfoliation of bone, contraction of the tendons in the neighbourhood of the stump.

With regard to the treatment of these affections,—

*a. Hæmorrhage* has been considered under that head, p. 201.

*b. Spasms of the muscles* may be relieved by shifting of position, laying the hand lightly on the stump, or by the administration of anodynes.

*c. Excessive pain* must be relieved by anodynes.

*d. Undue inflammation* may be relieved by the application of cold, as from an irrigator, or by light warm poultices, application of leeches, and the administration of salines, care being taken not to induce vomiting or excessive purgation.

*e. Osteo-myelitis* has been considered under that head.

*f. Inordinate retraction* of the soft parts, exposing bone. Nothing can be done for this until the inflammation consequent upon the operation has subsided, when it will be necessary to open up the stump, and remove the exposed bone.

*g. Necrosis.* The stump must be opened up, and bone removed high up.

*h. Neuralgia.* Soothing anodyne applications, such as opium, belladonna, or stramonium.

*i. Strumous degeneration.* Secondary amputation may be advantageously performed.

*j. Aneurismal enlargement* of the vessels is very rare. Mr. Cadge has reported one case of it.

*k. Exfoliation of the bone.* As little interference as possible, as in time the dead portion will be thrown off.

*l. Contraction of the tendons* in the neighbourhood of the stump. If causing inconvenience, and giving annoyance, the tendons may be divided.

*m. Maggots in stumps* have been already considered, p. 159.

## HÆMORRHAGE.

THE occurrence of hæmorrhage from wounds in war may be divided into primary or immediate, intermediate, and secondary.

Some writers on military surgery are of opinion that *primary hæmorrhage* to a dangerous extent is comparatively rare, and it is generally admitted that few cases come under the notice of surgeons on the field of battle; this, however, may be in consequence of severe injuries to large arteries proving fatal almost immediately, and the sufferers do not then come under the notice or observation of the surgeon. Mr. Hamilton, of the U. S. A., remarks: "It is one peculiar feature of gun-shot injuries, that in proportion to the number and severity of accidents, profuse arterial hæmorrhage is rare. The wounds inflicted by the missiles employed are generally contused and lacerated, seldom incised; and the same general laws as to bleeding, which govern contused and lacerated wounds elsewhere, and from other causes, govern here."\*

I experienced only one fatal case from hæmorrhage among many wounded who came under my notice during the siege of Sevastopol and other services. A brother officer was wounded in the right axilla, dividing the axillary artery. The night was very dark, he was warmly clothed, there were no lights to examine the nature of the wound, and he had to be carried a considerable distance before he could be attended to. On reaching the camp hospital, it was found the poor fellow had expired from hæmorrhage.

Dr. Valentine Mott is of opinion that many men perish on the field from hæmorrhage, or are so much reduced as to preclude all chance of recovery.

Arteries, when wounded by extremities being torn off by round shot or shell, seldom bleed. Nature endeavours to establish a cure by the inner and middle coats of the vessel contracting, and subsequently by adhesive inflammation.

*When a large vessel is only partially injured*, the hæmorrhage from it may prove fatal in consequence of this contraction not taking place.

*Wounded arteries may be secured* by either cutting directly down on the *wounded part* and tying the vessel there, or by applying a ligature to *both ends* if it be completely divided.

Guthrie recommends that *two great principles of surgery* should be ob-

\* Hamilton's 'Military Surgery,' p. 197.

served in cases of wounded arteries, and ought never to be absent from the mind of the surgeon:—

1. "That no operation ought to be performed on a wounded artery *unless it bleed*.

2. "That no operation is to be done for a wounded artery in the first instance, *but on the spot injured*, unless such operation not only appears to be, *but is, impracticable*."

He considers, that "when the femoral artery has been fairly divided in the lower part of the thigh, the patient has, in almost all the cases which have come under observation, either died without assistance, or the hæmorrhage has ceased spontaneously. Having been thus arrested for twelve hours, the efforts of Nature are usually sufficient to prevent its return from the upper, although not from the lower end of the vessel; but then it is of venous and not of arterial colour. The great evil to be dreaded in such cases is not from hæmorrhage from the upper end of the divided artery, but from the lower, and from mortification of the foot."\*

The greater number of competent authorities of the present day agree with Mr. Guthrie in his recommendation to cut down directly upon the wounded part of the injured artery, for the following reasons:—That the ligature of the main trunk at a distance above it would only stop the direct supply of blood to the limb; but it would not interfere with the anastomosing circulation, and blood would find its way to the distal aperture of the artery; that it may not be possible for the surgeon to ascertain the exact artery the bleeding is coming from unless he looks for it, and instances have been known where main trunks of arteries have been tied, and the hæmorrhage has been from some small vessel unconnected with it. Stromeier is of opinion that the plan of tying a wounded artery at the spot often does very well in minor vessels, but it often fails in the femoral artery. The large vein accompanying the artery has often been torn or bruised by the same bullet. After tying the artery at the spot, the vein often becomes totally impervious, and the hæmorrhage recurs, or the limb becomes gangrenous. It may be proper, in some cases, to gain time by putting a ligature above the wounded spot; before new hæmorrhage occurs, the vein may have undergone a favourable change. In other cases it is better to amputate.

It has been recommended that "in *cutting down on a wounded artery*, a large probe should be passed to the bottom of the wound, and, taking this as a centre, a free incision should be made in such a direction as may best lay open the cavity with the least injury to the muscles and soft parts. After turning out any coagula contained in the wound, and clearing it out as well as possible, the injured vessel must be sought for." Great care

\* Guthrie's 'Commentaries,' pp. 192, 193.

should be observed in ligaturing the vessel in consequence of the altered condition of the structures, from inflammation or infiltration.

*Wounds of arteries of neck* should be cut down on, and the vessel tied as already described for wounds of arteries elsewhere ; but this is sometimes very difficult, especially after direct pressure has been applied to the injured part. The common trunk should then be tied.

Velpeau, whose opinion Guthrie quotes with great satisfaction, says : "In hæmorrhage from the neck, the mouth, the throat, the ear, or the skull, *everything should be done to reach the branch of the carotid* which has been wounded, rather than the trunk itself."

*Intermediary hæmorrhage* may occur some hours after receipt of wound, or as soon as the patient becomes warm, and reaction is completely established.

*Secondary hæmorrhage* may occur from the fifth to the twenty-fifth day after infliction of an injury.

It may be produced by local or constitutional causes, the former being any movement which may disturb the wound or increase the rapidity of the circulation : as, for instance, transporting wounded too soon, which is sometimes unavoidable.

The imperfect application of a ligature.

By sloughing or ulceration of a large vessel.

By projecting spiculæ of bone injuring a vessel, which has taken place at a remote period.

By peculiar *hæmorrhagic diathesis*, which exists in some persons, but on service in the field generally presents itself when the men are worn out by fatigue and privation ; this some authorities believe to be due to pyæmic poisoning, whether attended or not by phlebitis or thrombosis.

Legouest remarks on this latter form of hæmorrhage : "Inasmuch as the troops are subjected to protracted hardships, so do their powers of resistance diminish. At the same time that the general health and constitution of the soldier are affected, his wounds heal less rapidly, or take on characters of a grave nature ; operations become less successful, and secondary hæmorrhages enter more into the non-success of surgery, practised under circumstances becoming progressively more and more disadvantageous."

Stromeyer describes it as *parenchymatous hæmorrhage*, and considers the condition due to the entrance of air into the veins, and a stoppage of the larger veins by coagulation.

*Hæmorrhage from Stumps*.—When hospitals are crowded and badly ventilated, hæmorrhage frequently occurs from the face of stumps, giving rise to great anxiety and trouble. This is no doubt due to constitutional debility, and will have to be treated accordingly.

Hæmorrhage occurring from stumps may take place a few hours after

the ligature has been applied ; about the period of separation of ligature ; and at any period after its separation.

In the first instance it may occur from reaction or from disease of the arterial coats, giving a certain amount of warning by general oozing.

When it occurs at a later period, it may be from causes interfering with the formation of the coagula, or producing ulceration of the coats, or the stump may be irritable and inclined to slough.

*The treatment of hæmorrhage from a stump at an early period* must be prompt ; the maxim that held good in primary hæmorrhage not to interfere with a vessel unless it bled, will not answer here. Bleeding having occurred more than once, active measures must be adopted. After having tried elevation of the stump, the application of tourniquet, pressure by means of bandaging stump, so as to press the flaps together, and the application of cold, without checking the hæmorrhage, it will be necessary to open the wound, and make a search for the bleeding vessel.

It frequently occurs that there is some difficulty in isolating a bleeding vessel in a stump. It may then be secured by passing a curved tenaculum through the tissues immediately surrounding the vessel, and placing a strong ligature around the whole. It may also be secured by thrusting a needle armed with a ligature through the tissue in the direction of the bleeding vessel, and endeavouring to seize it along with the surrounding tissue.

If the vessels are softened, and will not hold the ligature, success sometimes attends the application of the solution of the perchloride of iron or the actual cautery.

*Should hæmorrhage occur at a later period*, when the ligature might be expected to come away, and the stump is irritable and inclined to slough, the surgeon may select one of the four following alternatives: Apply tourniquet ; open up the stump and tie the vessels ; ligature the main artery immediately above the stump ; or tie the vessel high up in limb at a distance from the stump. Mr. Guthrie remarks on this description of hæmorrhage : " In irritable and sloughing state of stump, hæmorrhages frequently take place from the small branches, or from the main trunks of the arteries in consequence of ulceration ; and it is not always easy to discover the bleeding vessel, or when discovered to secure it on the face of the stump ; for as the ulcerative process has not ceased, and the end of the artery which is to be secured is not sound, no healthy action can take place ; the ligature very soon cuts its way through, and the hæmorrhage returns as violently as before, or some other branch gives way. Some surgeons," he says, " have, in such cases, preferred cutting down upon the principal artery of the limb, in preference to performing another amputation, even when it is practicable ; and they have sometimes succeeded in restraining the hæmorrhage for a sufficient length of time to allow the stump to resume a more healthy action. This operation, although suc-



cessful in some cases, will generally fail, and particularly if absolute rest cannot be obtained, when amputation will be necessary. The same objection of want of success may be made to amputation; on a due comparison of the whole attending circumstances, the operation of tying the artery in most cases is to be preferred in the first instance, and if that prove unsuccessful, then recourse is to be had to amputation; but this practice is by no means to be followed indiscriminately.

"To obviate all doubt, the parts from which the bleeding comes should be well studied, and the shortest distance from the stump at which compression on the artery commands the bleeding carefully noted; at this spot the ligature should be applied, provided it be not within the sphere of the inflammation of the stump. In case the hæmorrhage should only be restrained by pressure above the origin of the profunda, and repeated attempts to secure the vessel on the surface of the stump have failed, amputation is preferable to tying the artery in the groin, when the strength of the patient will bear it."\*

*Expedients for suppressing hæmorrhage* may be divided into temporary and permanent, and as operating either indirectly on the trunks conveying the fluid to the point or directly on the orifice of the bleeding vessel.

*In case of severe hæmorrhage on the field of battle*, the first impulse on the part of the surgeon or his attendant is to check the bleeding by placing his fingers in the wound, or applying a tourniquet to the main trunk. The latter may not be available; it would, therefore, be necessary for an attendant to apply pressure with his fingers even during transport, in the event of the bleeding being from a large vessel.

Bleeding can frequently be checked by *plugging* a wound; but this may be followed by grave symptoms, in consequence of the blood becoming diffused, giving rise to an aneurism or to gangrene.

*The tourniquet is the chief temporary means*, which in its primitive state was simply a band to go round the limb, with a pad placed immediately over the vessel, and the whole tightened by means of a bayonet or piece of stick.

To Petit we are indebted for the screw tourniquet; and since his time there have been many modifications, nearly all with a view to stop the current of blood through the main artery of the limb, and at the same time to admit of a certain amount of circulation being carried on.

It was found that with wounded men having the old-fashioned twisted strap, or the more modern screw tourniquet, applied to a limb, and transported for any distance without surgical assistance, the tourniquet frequently shifted, or the man *lost the limb from gangrene*. To obviate this, and admit of a wounded man retaining the instrument for a considerable time, either during transport or until the services of a surgeon might be

\* Guthrie's 'Commentaries,' pp. 55, 56.

available, Dr. A. B. Mott, U. S. A., invented one with bands or hoops of iron or brass, which Mr. Hamilton describes as "a very ingenious field tourniquet (fig. 108), which is easily applied, and may be considered safe

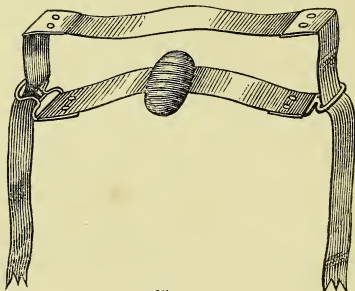


Fig. 103.

even in the hands of those who know nothing of the danger of ligating limbs too tightly, since the compression is applied at only two points in the circumference of the limb."\*

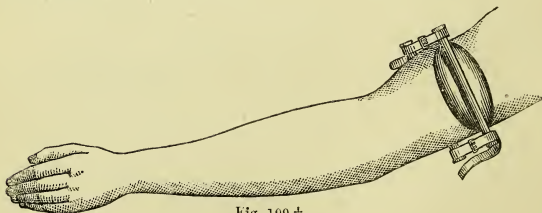


Fig. 109.†

Professor Esmarch, in his work on bandaging, describes a tourniquet for the field invented by Volckers, which, he considers, on the lower part of the upper arm, can be applied with much less danger than the usual circular

\* Hamilton's 'Military Surgery,' p. 145.

† 'Verbandplatz und Feldlazareth,' by Dr. F. Esmarch, p. 13.

tourniquet. Volckers found it was easy to make the pulse above the elbow disappear by crossing the arm with a stick at the proper angle of the axis of the bone. This apparatus (fig. 109) can be made with two little round sticks of about eight inches in length, one for the inside, and the other for the outside of the arm, which he keeps in position by means of straps. On the centre of the inner stick he attaches a pad, which is placed immediately over the artery, and by tightening the straps is brought to bear on the vessel.

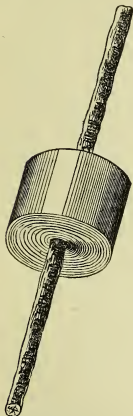


Fig. 110.

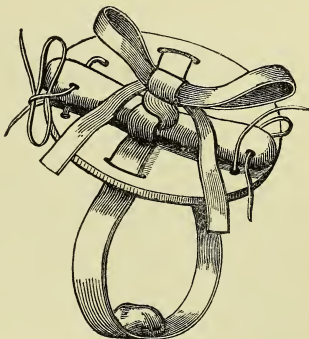


Fig. 111.

For pressure on the femoral artery in the upper part of the thigh, Professor Esmarch gives an illustration of an apparatus which can be easily constructed. A bandage is to be rolled on the middle of a stick at least a foot in length; then this bandage is to be placed against the artery, and tightened by means of a strap and strong buckle passed behind the limb and over each end of the stick; by this means continued pressure can be maintained (fig. 110).

*An artery compress for field purposes* is given in a Swiss manual, an account of which may be found useful. It is composed of a pad, bandage,

round piece of strong leather, a short stick, and two strings. In order to apply it, the compress is laid on the limb with the pad next the artery, and the plate of leather on the opposite side. The two ends of the bandage are then tied over the plate, the stick pushed under it, and twisted till the bleeding ceases. The stick can then be kept in position by means of strings which fasten each end to the plate, and prevent it turning round (fig. 111).\*

*Several ingenious modifications have been made of the ordinary screw tourniquet*, whereby the strap is carried clear of the sides of the limb. These have been effected by the addition of metal wings, over which the strap is carried.

*The expedients that may be employed for the permanent arrest of hæmorrhage* are—pressure, ligature, torsion, acupressure, flexion, cauterization, application of cold, styptics, exposure to air, position.

*Torsion of arteries*, though used in former times, fell into disuse, and was revived by Amussat and Velpeau. During the Franco-German War of 1870-71, Mr. MacCormack appears to have used it with marked success. He says: "I twisted the vessels in a very large number of cases of amputation for gun-shot wounds. I only remember a single instance of secondary hæmorrhage from a twisted vessel. It was a case of amputation through the knee-joint, in which acute pyæmia supervened. Torsion," he says, "is more difficult and tedious in its application than a ligature. It is inapplicable when the arteries are diseased."†

It is doubtful if it is a safe expedient in the field, especially if it is necessary to transport the sufferer immediately after its application.

Mr. MacCormack, for the smaller arteries, used unlimited torsion. For the large vessels lying loosely in unaltered sheaths, he considers it better to limit the length of artery twisted by grasping the vessel with a second forceps, otherwise the artery may be needlessly and dangerously disturbed in its relations to its sheath. He twists until he feels the internal coat giving way.‡

Mr. Spencer Wells has introduced a new kind of artery and torsion forceps, which very conveniently replace the old spring artery forceps of Liston, and the bull-dogs used for the temporary stoppage of bleeding vessels during operation, while they are the most readily applied of any of the varieties of torsion forceps met with.

The grasping and holding extremity is roughened by rather deeply-cut transverse teeth (fig. 112), so that the bleeding vessel is forcibly compressed and its coats almost crushed together. This is alone sufficient to stop the bleeding without any torsion, especially if the instrument be left on the vessel for a minute or more.§

\* 'Manual for the Use of those Attending Wounded.' Berne, 1871.

† 'British Medical Journal,' January 10th, 1874.

‡ Ibid.

§ Ibid.

*Acupressure* may be applied in several different ways, the object in all being to compress the mouth or bleeding orifice of the artery against tissue or bone.

In bleeding from a stump where the interosseous artery of the leg has been divided high up, hæmorrhage has been suppressed by a long acupressure needle being passed through the stump, so as to press the artery against one of the bones.

*Flexion* may be used for hæmorrhage from the forearm, hand, lower leg, or foot, by placing a piece of lint or handkerchief rolled up in the bend of

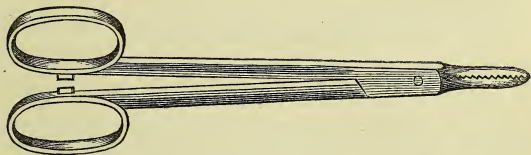


Fig. 112.

the elbow or under the knee; then flex the limb and fix it. In the event of a tourniquet not being available, this proceeding might be used with advantage.

*Cauterisation* is now seldom used; at the same time it may be found of use in hæmorrhage from the surface of irritable and indolent stumps, or in gun-shot wounds of the tongue. It is recommended that the iron which is used for the purpose of cauterisation should be at a black heat, being considered more effectual in that condition than at a red or white heat.

*The application of ice or cold* is nearly always attended by satisfactory results in wounds of very small vessels, favouring the coagulation of the blood. Mr. Hamilton is of opinion that *hot water* will accomplish this end more promptly than cold, and it is especially appropriate when the patient is feeble and exhausted by shock.

*Styptics* were much used in former days, but at present are not popular. They act by causing the blood to coagulate rapidly and firmly, but should only be used when there is oozing from parts where other applications cannot be conveniently made. Styptics are unfortunately most objectionable, as they act injuriously on the tissues to which they are applied, causing much pain and tendency to extensive sloughing or suppuration, and rendering healing by first intention impossible.

During the War of the Rebellion in America, the persulphate of iron in powder and perchloride in solution were largely employed for both primary

and secondary hæmorrhage. The report of the Surgeon-General of the U. S. Army says that they caused great suffering to the patients, increased inflammatory phenomena, and converted tissues into blackened masses, interfering with ligaturing of vessels.

The styptics generally used are the perchloride of iron, matico, turpentine, gallic acid, alum, nitrate of silver, chloride of iron, and mineral acids.

Langenbeck has prescribed a solution of ergot in glycerine, to be used as a hypodermic injection in cases of hæmorrhage and in the treatment of aneurism. Proportion—one grain of ergotine to six minims of glycerine. Two minims for an injection. This I tried in two cases of aneurism without any satisfactory result.

*Wounds of Veins.*—Unless from some large and deep-seated trunk, hæmorrhage from wounded veins is seldom dangerous.

If the wound of the chief vein of an extremity is complicated with wound of its artery, the case must be looked upon as most serious, being generally followed by gangrene of the limb. Such a case came under my notice during the Crimean War.

*In ordinary cases of venous hæmorrhage*, the bleeding may be restrained by pressure or elevation of the limb; but if there is any difficulty in checking it, acupressure or ligature may be applied. Hennen remarks on this subject: "When the great veins bleed I have never hesitated about tying them, and it is most particularly necessary in debilitated subjects." During the Crimean War the writer experienced several instances of troublesome bleeding from veins after amputation, delaying the closing of stumps, which he secured by means of fine ligatures, without any ill consequences.

*Punctured Wounds of Arteries.*—Guthrie recommends that in all cases of punctured wounds, when pressure can be effectually made, and especially against a bone, it should be tried in a graduated manner over the part injured, in the course of the artery above and below the wound; and, if in an extremity, over the whole limb generally, the motions of which should be effectually prevented, and absolute rest enjoined if the artery is of importance. This should be continued for two, three, or more weeks, according to the nature of the injury.

*Diffused traumatic aneurism* may be the result of a wounded or ruptured artery; the blood is poured out into the surrounding tissue, but is limited in its extent by coagulation and pressure of the neighbouring parts. There is no sac. The treatment in these cases is to lay open the tumour, remove coagula, and ligature the vessel above and below the wound in it.

*Circumscribed traumatic aneurism* may be induced in two ways from wounds of arteries:—

First: A vessel having received a puncture, the external wound heals, the blood is extravasated into the neighbouring tissue; this becomes dense and firm, is surrounded by layers of fibrine, and from continued pulsation a

sac is formed. This form of aneurism is liable to occur in punctured wound of the palmar, radial, ulnar, and temporal arteries.

The treatment should be, if a small artery, to lay the tumour open, remove coagula, and ligature the artery at the seat of injury. It may, however, be necessary to tie the main trunk in the event of the vessel being very large, which should be done close to the sac.

The second form of circumscribed aneurism may be induced from a similar wound as above, but both external wound and wound of artery heal, the cicatrix of the latter becomes weak and gradually dilates from the pulsations; or it may be produced by a bullet bruising the artery and weakening its coats. A tumour is formed, which may attain a considerable size. This form of aneurism is more likely to occur in large arteries, such as the axillary, femoral, and carotid.

The treatment recommended is to try and consolidate the tumour by pressure on the main trunk. If this does not succeed, the vessel may be ligatured at the tumour, or it may be necessary to ligature the main artery at a distance from the sac.

Should the sac be very large and likely to give way, or should it give way, the practice recommended is to lay it open, turn out coagula, and ligature the artery above and below the wound.

Bullets have been known to pass between an artery and a vein, injuring both and establishing a communication, causing what is known as an *aneurismal varix*. Surgical interference is not recommended in such accidents, unless a very large tumour is formed, which is likely to give way and endanger the life of the patient, when the artery should be cut down upon, and a ligature applied on each side of the wound.

An artery may receive such injury from contact with a missile as to *produce arteritis*, characterised by tenderness along the course of the vessel, cessation of pulsation in its terminal branches, intense pain in the limb, and possibly followed by dark dry gangrene.

The treatment will have to be regulated according to the stage of the disease. If seen early, antiphlogistic treatment may subdue the inflammatory action; otherwise, amputation at point of obstruction, should gangrene have taken place.



## LIGATURE OF ARTERIES.

THE instruments required for application of a ligature to an artery in its continuity are a scalpel, not too pointed, with a flat handle for pressing aside the tissues; a good-sized forceps; an aneurism needle; retractors; a ligature; needles and thread. In cutting down on an artery it may be only necessary to follow up a wound, which point should always be observed, the original wound being taken advantage of.

Mr. Erichsen gives such excellent instructions for cutting down on an artery that they may be repeated here with advantage:—

“In making the first incision, the skin should be put on the stretch by the fingers of the left hand, or by those of an assistant. If the artery be superficial, or if there be parts of importance in its vicinity, the incision should not penetrate deeper than the skin. But if the vessel be deeply seated and no parts of importance intervene, it may be carried at once through the subcutaneous areolar tissue, until the fascia covering the artery is exposed. This must then be pinched up with the forceps, and opened by the edge of the scalpel laid horizontally. Through this opening a grooved director may then be passed, and the fascia incised on it, without risk to subjacent parts. The sheath of the vessel is now exposed by a little careful dissection; and the next step of the operation, which consists in exposing



Fig. 113.

the artery and separating it from its accompanying vein, is one of great delicacy. This is done by pinching up the sheath with the forceps and applying the knife horizontally. The artery having been exposed, the surgeon seizes one edge of the sheath with the forceps, and putting it on the stretch, generally separates the artery from its accompanying vein by tearing through the areolar connections with the end of the aneurism-needle, or with a director; being careful not to expose it to a greater extent than is absolutely necessary for the passage of the ligature. The ligature should be passed between the vein and the artery, care being taken only to include the latter, and especially not to transfix and include a portion of the vein.\* The artery should be tied tightly with a reef-knot, which does not slip” (fig. 113).

The following table may assist in showing when the separation of liga-

\* Erichsen's 'Science and Art of Surgery,' vol. 1., p. 181.

tures from large arteries may be anticipated, at which period hæmorrhage is likely to occur :—

Common iliac, 18th to 25th day ; external iliac, 15th to 22nd day ; femoral, 14th to 18th day ; subclavian, 17th day ; carotid, 20th day ; brachial, 21st day ; axillary, 22nd day.

*Ligature of Common Carotid.*—This operation may be performed above or below the omo-hyoid muscle.

*Above the Omo-hyoid, or in its Superior Stage.*—The first incision should commence a little beneath the angle of the lower jaw, and terminate on the side of the cricoid cartilage. This incision will divide the skin, platysma myoides, and cervical fascia, and expose the sheath of the vessels, with the descendens noni nerve lying in its front. The nerve is to be drawn outwards, and the sheath opened in a cautious manner. The needle is to be carried around the vessel from without inwards, taking care not to wound the jugular vein or include the pneumogastric nerve.\*

*Below the Omo-hyoid Muscle, or in its Inferior Stage.*—An incision through the integuments along the internal margin of the sterno-mastoid muscle for about three inches above the clavicle. A portion of the fascia, at the lower end of the incision, should be raised in the forceps and divided in a horizontal direction. Through this opening a director should be introduced from below upwards in the line of the first incision, and the fascia slit upon it as far as necessary. The sterno-mastoid having been drawn outwards, and sterno-thyroid and sterno-hyoid inwards, the sheath of the vessel will be thus exposed. The ligature is to be passed round the artery, directing the needle from without inwards. On the front of the sheath will be found the internal branch of the descendens noni nerve.†

*Ligature of External Carotid.*—“An incision from angle of jaw to level of the thyroid cartilage, which should expose the digastric muscle. The artery may be tied above or below the crossing of the posterior belly of this muscle. The superior laryngeal nerve, which lies behind the origin of the vessel, must be avoided.”

*Ligature of the Lingual Artery.*—This artery may be exposed by an incision extending transversely from the os-hyoides to the margin of the sterno-mastoid muscle. The skin, platysma, and fascia being divided, the glistening tendon of the digastric muscle is brought into view ; beneath this, and lower down, is the hypo-glossal nerve, much duller in its appearance than the tendon ; whilst the artery will be found situated still lower, and a little deeper than the nerve.‡

*Ligature of the Innominata and Subclavian Arteries.*—Raise the shoulders of the patient, and allow the head to fall backwards, by which the artery will be drawn a little from within the chest. Let an incision be made over

\* ‘Anatomy of the Arteries of the Human Body,’ by J. H. Power, p. 65.

† Ibid., p. 65.

‡ Ibid., p. 75.

and down to the sterno-cleido-mastoideus muscle, the sternal origin of which, and nearly the whole of the clavicular origin, should be divided on a director carefully introduced below it, avoiding some small veins which run below and parallel with its origin. An incision is now or previously to be made, two inches in length, through the integuments along the inner edge of the muscle, which will admit of its being raised and turned upwards and outwards. Some cellular texture being torn through, the sterno-hyoideus muscle is brought into view, and should be divided on a director. The sterno-thyroideus is then to be cut through in a similar manner. A strong fascia and some cellular texture here cover the artery, having the large nerves running beneath it, the carotid being to the inside, the internal jugular vein to the outside. By following the carotid downwards, the finger will rest on the innominata and on the origin of the subclavian, and a ligature may be placed on either. If on the innominata, the aneurismal needle should be passed from without inwards, immediately below the bifurcation, close to the vessel. If on the subclavian, the ligature should be applied close to the vertebral artery, the needle being passed from below upwards, the greatest care being taken to avoid the recurrent nerve, which separates it from the par vagum at this part.\*

*Ligature of Subclavian Artery in its Third Stage.*—Shoulders should be elevated, with a good light falling directly on the parts. An incision commencing at the external margin of the sterno-mastoid muscle, immediately above the clavicle, and continued outwards for about three inches. Having divided the platysma-myoides and fascia, the lips of the wound should be separated, and any fibres of the trapezius which appear in the way must be carefully divided on a director. The external jugular vein will now come into view, and should be drawn to the sternal end of the wound, but may be drawn to the acromial side if more convenient. The deep fascia must now be carefully scraped through, especially its connection with the scalenus anticus, and by tracing this muscle to its insertion with the first rib, the artery is at once reached, lying behind the insertion. Care must be taken not to injure the pleura, which lies immediately behind and below the vessel.

*Ligature of the Axillary Artery.*—This artery may be tied in its first and third stages. Delpech, however, has tied it in its second stage, by dividing the pectoralis minor muscle.

*First Stage:* "A semilunar incision, with its convexity downwards, extending from half an inch outside of the sterno-clavicular articulation to very near the coracoid process, stopping just before it arrives at the edge of the deltoid. This incision must include skin, fascia, and platysma, and the flap must be turned upwards. The clavicular portion of the pectoralis major muscle must be divided, the fibres of the pectoralis minor should be drawn to one side, when the artery will be felt pulsating, being only

\* Guthrie's 'Commentaries,' p. 287.

covered by the costo-coracoid membrane; this must be carefully scratched through. The nerves should then be pulled outwards, and vein downwards and inwards, and the needle passed from within outwards."

*Third Stage*, through base of the axilla: The arm being abducted and supinated, an incision should be made about two and a half or three inches in length, through the integuments and fascia of the axilla. The coracobrachialis muscle being ascertained, will form a good guide to the vessel, and by scraping through the cellular tissue the axillary vein will come into view. The needle should be passed round the artery from within outwards.

*Brachial Artery in Upper Part of the Arm.*—The inner edge of the biceps muscle forms a good guide to the position of the artery. The arm being abducted and rotated outwards, an incision should be made about two and a half inches long, on the internal margin of the biceps. Having divided the fascia, the basilic vein will probably be exposed, and must be carefully avoided. The biceps muscle should now be drawn to one side, and the artery may be exposed.

*Ligature of the Ulnar Artery at its Origin.*—Mr. Guthrie recommends that, if the artery be wounded near its origin, "an incision should be made through the integuments and the aponeurosis of the biceps muscle; the pronator muscle being then exposed, it is to be drawn inwards and downwards, or towards the ulna, and the dissection continued until the median nerve is brought into view. The probe introduced through the original wound will lead to the artery, the pulsation of which will be felt and the bleeding seen."\*

To tie the ulnar artery at its lower end, make an incision at the interval between the flexor sublimis digitorum and flexor carpi ulnaris. The needle should be passed round the vessel from within outwards, taking care to avoid the nerve which lies to its ulnar side and *venæ comites* on either side.

*Ligature of the Radial Artery.*—This artery may be tied in upper or lower part of forearm.

*Operation in the Upper.*—Here the artery lies in the interval between the supinator longus and the pronator radii teres. In a muscular arm, the edge of the former muscle is the best guide; in a fat one, the incision may be made in a line extending from the centre of the bend of the arm to the inner edge of the styloid process of the radius. The deep fascia must be exposed and opened, and the muscles relaxed and held aside.†

*Operation in the Lower.*—Here the vessel is more superficial, lying in the groove between the flexor carpi radialis and supinator longus. An incision two inches in length, and parallel with these tendons, easily exposes the artery.†

\* Guthrie's 'Commentaries,' p. 294.

† 'Manual of Operations of Surgery,' p. 43.

*Ligature of Internal Iliac Artery.*—"An incision should be made in the direction of a line extending from the umbilicus to midway between the spine of the pubis and the anterior superior spine of the ilium. This incision should commence at the outer edge of the rectus muscle, and terminate about an inch above Poupart's ligament, in order to avoid the spermatic cord. The different muscular layers composing the anterior wall of the abdomen being successively divided, the transversalis fascia should be cautiously scraped through, and the peritoneum exposed and pushed inwards. The fascia covering the vessels should also be torn with the nail, and then, by following the external iliac artery backwards, we arrive at the internal. In the angle between them lies the external iliac vein, which should be carefully avoided, and the needle introduced from within outwards."\*

*Ligature of External Iliac.*—"An incision must be made through the skin about four inches in length, but longer in proportion to the amount of subcutaneous fat and the depth of the pelvis, extending from a point one inch to the inside of the anterior superior spine of the ilium, to a point half an inch above the middle line of Poupart's ligament. It must be slightly curved, with its convexity looking outwards and downwards.

"The subcutaneous cellular tissue, and the tendon of the external oblique, may then be divided freely in the same line. Then at some one point or other, the internal oblique and transversalis muscles must be cautiously scraped through with the aid of the forceps, till the transversalis fascia is reached; they may then be freely divided by a probe-pointed bistoury (guarded by the finger pushed up below the muscles) to the required extent.

"The fascia transversalis must be carefully scratched through near the crest of the ilium, and thus the operator will be enabled to push the peritoneum inwards, and by the forefinger will easily recognise the pulsation of the artery.

"The ligature should be passed from the inner side to avoid including the vein."†

*The Common Iliac Artery* may be arrived at for the purpose of including it in a ligature by the proceeding recommended for tying the internal iliac.‡

*Ligature of Gluteal Artery.*—"Draw a line from the posterior superior spinous process of the ilium downwards to the mid-point between the tuberosity of the ischium and the great trochanter; and then divide this line into three equal parts; the gluteal artery will be found emerging from the pelvis, at the junction of its upper and middle thirds."

*Ligature of the Femoral Artery.*—This artery may be tied immediately below Poupart's ligament, as recommended by Professor Porter, of Dublin

\* 'Anatomy of Arteries of the Human Body,' by J. H. Power, pp. 255.

† 'Manual of Surgical Operations,' by J. Bell, F.R.C.S., p. 9.

‡ 'Anatomy of Arteries of the Human Body,' p. 253.

(and practised successfully by his son, Surgeon G. H. Porter), in Scarpa's space, or middle of the thigh.

In the first position (Professor Porter's), it has been tied for a wound of the profunda femoral artery, and can be reached by making a transverse incision through the integuments, and so reaching the artery whilst enclosed within the funnel, and of course before it had given origin to the profunda.

*Ligature of Femoral Artery in Scarpa's Space.*—"The patient being placed on his back, and thigh rotated slightly outwards, an incision should be made through the integuments, commencing about two inches beneath Poupart's ligament, and extending for about three inches in length over the course of the artery, which can be ascertained by its pulsation. The fat and superficial fascia should next be divided. The fascia lata is then divided to the same extent of the skin, the sartorius drawn outward without opening its sheath. The sheath of the artery can now be opened, and the needle passed round the artery from within outwards."

*Ligature of Femoral Artery in the Middle of the Thigh.*—"In this position the artery may be reached by cutting the integuments on the internal or outer margin of the sartorius muscle. Mr. Hunter recommends the former proceeding. On drawing the muscle to one side, the sheath must be opened, and as the vein has altered its position, the needle should be passed from without inwards."

*Ligature of the Popliteal Artery.*—"In its superior third, this artery may be exposed by an incision on the external margin of the semi-membranosus muscle, closely applied to which is the popliteal nerve: the muscle being drawn inwards, and the nerve outwards, the vein will be found closely applied to the posterior or cutaneous surface of the artery, and projecting a little to its outside; great caution is therefore necessary in separating these vessels from one another, and the needle should be passed from without inwards.

"The vessel may be secured in its inferior third by a vertical incision between the heads of the gastrocnemius muscle. The posterior saphenous nerve and vein being drawn out of the way, the popliteal nerve will be brought into view. Deeper, and more externally, is the vein; and still deeper, and projecting on the outside of the vein, is the artery. The nerve may be drawn to the inside, and the vein either internally or externally, as may be found most convenient. The needle is to be introduced with its convexity to the vein."\*

*Ligature of Posterior Tibial Artery.*—"The course of the artery corresponds with a line drawn from the middle of the popliteal space to the middle of the space between the heel and inner ankle. To tie the vessel in the upper part of the leg, an incision four inches long, half in the upper

\* 'Anatomy of the Arteries of the Human Body,' by J. H. Power, M.D., p. 327.



and half in the middle third of the leg, should be made through the skin and fascia. This incision should be about one inch from the tibia, or a little more if the patient is stout.

"The deep fascia is next to be divided, which will expose the edge of the gastrocnemius, which is to be drawn aside, when the soleus will come into view, the fibres of which are to be severed to the extent of the first incision, and until the fascia covering its anterior surface is seen; this is to be perforated and divided, when the vessel will be found lying on the tibialis posticus, surrounded by the fascia which intervenes between the superficial and deep layer of muscle."

*To tie the Posterior Tibial in the Middle of the Leg.*—"An incision three inches long, half in the middle third and half in the lower, and midway between the inner edge of the tibia and the inner border of tendo-Achillis. After dividing the fascia, the artery will be found surrounded by fat along the inner edge of the flexor longus digitorum, accompanied by two veins, the nerve to the outer side."

*To tie the Posterior Tibial at the Ankle.*—"A curved incision two-and-a-half inches long, in the groove, midway between the hinder edge of the internal malleolus and the extremity of the heel."

*Ligature of Anterior Tibial.*—"A line drawn downwards from the head of the fibula to the base of the great toe, or, as some recommend, from the prominent portion of the external condyle of the tibia, anterior to the superior tibio-fibular articulation, will correspond with the position of the artery and the tendinous intersection between the tibialis anticus and the extensor digitorum communis muscle.

"At the instep this artery may be exposed by an incision between the tendons of the extensor digitorum communis and extensor pollicis longus."

*Ligature of Peroneal Artery.*—"An incision, extending from midpoint between the tendo-Achillis and the external malleolus, four inches upwards and outwards towards the fibula. The fibres of the flexor pollicis longus should be detached from the fibula as far as necessary, and drawn to one side, when the vessel will be found lying on the interosseous ligament close to the fibula."

*Ligature of the Aorta.*—"A straight incision in the linea alba, just avoiding the umbilicus by a curve, and dividing the peritoneum, allows the intestines to be pushed aside, and the aorta exposed still covered by the peritoneum, as it lies in front of the lumbar vertebræ. The peritoneum must again be divided very cautiously at the point selected, and the aortus plexus of nerves carefully dissected off, in order that they may not be interfered with by the ligature. The ligature should then be passed round, tied, cut short, and the wound accurately sewed up."\*

\* 'Manual of Surgical Operations,' by J. Bell, p. 2.



*The operation of lithotomy* may be required in war time for the removal of bullets or other missiles from the bladder. The operation (lateral) is thus described by Sir W. Fergusson:\* “The point of the blade of scalpel should be entered about one inch and three-fourths in front of the anus, about a line’s breadth left of the raphe, pushed through the skin, and carried by a kind of sawing motion down the left side of the perineum, about an inch and a quarter beyond the anus, the middle of the incision being at equal distances from the latter part and tuberosity. Next the blade should run along the surface of the exposed fat and cellular tissue, and then the point of the forefinger of the left hand should be thrust into the wound a little in front of the anus, so as to penetrate between the accelerator urinæ and the erector penis muscles—the knife being applied to any part which offers resistance; when, with a little force to separate the tissues, the tip of the finger can be placed upon the membranous portion of the urethra, and the groove in the staff may be distinctly felt. The point of the blade, with the flat surfaces nearly horizontal, should now be carried along above the finger, made to perforate the urethra about three lines in front of the prostate, and then be slid along the groove until it has entered the bladder, having slit open the side of the urethra and notched the margin of the prostate in its course. The fore-finger of the left hand should next be slipped slowly into the bladder along the staff, in such a manner as to cause dilatation of the surrounding textures, and its point should be moved about in search of the stone, which, being found, should be retained in position near the neck of the viscus; then the staff should be removed, and the forceps introduced along the upper surface of the finger, slowly withdrawing the latter as the former makes progress: this will be denoted by a gush of urine, at which instant the blades should be separated, when on gently approximating them the stone will in all probability be felt enclosed.”

\* ‘A System of Practical Surgery,’ p. 724.

## MORTIFICATION, OR GANGRENE.

THIS disease may have to engage the attention of the army surgeon as the result of gun-shot wounds, to which all are more or less liable, as the result of injury or ligature of the main artery of a limb, and of exposure to cold, privation, unwholesome food, scurvy, or other blood diseases.

In traumatic gangrene, or that induced by local causes, the parts may be so injured that they are killed outright, or cannot recover themselves, such as cases of severe bruises, laceration, wound of the main artery or vein of a limb interfering with the circulation, which frequently happens in gun-shot fractures when the splinters of bone or missile wound the artery, or in punctured or incised wounds of a large vessel allowing of extravasation. It has also happened from a bandage being applied too tightly.

In those cases occasioned by severe lacerations or bruises, only the parts originally injured die, and there is but little necessity for surgical interference. The local application of tepid water, or poultices with charcoal, or some fermenting agent, to which an antiseptic may be added, will be found comforting, and hasten the separation of the dead portions. The strength of the subject may be maintained by wine, nutritious diet, tonics of mineral acids, or quinine, and the patient's system, as far as possible, protected from poisoning by absorption of the decomposed animal substances which are in close connection with veins and absorbents.

The use of opium in these cases has a highly beneficial result, given in small and frequently repeated doses, or in full doses where there is great restlessness at night.

In gangrene resulting from a wound of the main vessels, or compound fracture, or any local cause, such as obstruction of the artery, the rule laid down by older surgeons was to wait for the line of separation before the parts were removed by amputation. This practice has, however, been set aside for some years.

Larrey established the rule that when mortification is the result of mechanical cause, and puts the patient's life in danger, we must not wait until the disorder has ceased to spread. This rule is still in force, and has the sanction of the highest authorities.

Mr. Guthrie gives two or three examples of the practice in extreme cases: "A soldier is wounded by a musket-ball at the upper part of the middle third of the thigh, and on the third day the great toe has become of a

tallowy colour, and has lost its life: what is to be done? Wait, with the hope that the mortification will not extend.

"Suppose that the approaching mortification has not been observed until it has invaded the instep: what is to be done? Wait, provided there are no constitutional symptoms; but if they should be present, or the discoloration of the skin should appear to spread, amputation should be performed forthwith, for such cases rarely escape with life if it be not done. Wherein such a case should the amputation be performed? I formerly recommended that it should be done at the part injured in the thigh. I do not now advise it to be done there at an early period, when the foot only is implicated; but immediately below the knee, at that part where, if mortification ever stops, and the patient survives, it is usually arrested; for the knee is by this means saved, and the great danger attendant on an amputation at the upper third of the thigh is avoided. When from some cause or other amputation has not been performed, and the mortification has stopped below the knee, it is recommended to amputate above the knee after a line of separation has formed between the dead and the living. This should not be done. The amputation should be performed in the dead parts, just below the line of separation, in the most cautious and gentle manner possible; the mortified parts which remain being allowed to separate by the efforts of nature." In mortification of the fingers, hand, or forearm, from wound of the axillary artery, the principle of the treatment should be the same.\*

Mr. C. H. Moore, in referring to obstruction of the principal artery of a limb in which gangrene should come on, says: The treatment will depend upon the rate of its progress and the state of the patient's system. No delay in amputation should be permitted when the mortification spreads rapidly, with swelling of the limb and decreasing depression of strength.

It may be permitted to wait for the formation of the line of demarcation, when the gangrene commences at the digits, and ascends slowly for days or weeks.

A limb affected with rapidly spreading gangrene should be amputated above the affected parts, and, as a rule, at the level of the obliteration of the artery. When, however, the femoral artery and vein have been divided by a mere cut as high as Poupart's ligament, and mortification of the foot supervenes, the limb may be removed at or a little below the knee.†

Legouest, in remarking on numerous local and constitutional treatments which have been employed for gangrene without benefit, says amputation is the only means of opposing it, and yet it is not always efficacious; he has obtained success in amputating at the line between the dead and the living

\* Guthrie's 'Commentaries,' p. 25.

† Holmes's 'System of Surgery,' vol. i., p. 754.

tissue where the parts are already infiltrated, but adds: "It is obviously better to amputate in the healthy parts, where one can choose the place."\*

The result of amputation for traumatic gangrene is on the whole unfavourable, the disease frequently recurring in the stump, or the patient sinking from exhaustion; and in those cases where the tissues are already infiltrated or disorganized the prospects from amputation are still more unfavourable.

Erichsen lays down the principle that there are two exceptions to the rule of amputating in traumatic gangrene before the occurrence of the line of demarcation; viz., gangrene from frost-bite, and that from severe burns. During the severe winter of 1854, when the allied armies were before Sevastopol, the writer witnessed several cases of gangrene of the feet from exposure, both in camp and in the trenches.

Those who were attacked by the disease in the trenches had their feet first wet by the mud and constant rain, when frost suddenly set in, and in consequence of the impossibility of moving about the circulation became arrested.

Those who were attacked in camp found their feet numb and helpless on rising in the morning, having lain down on damp ground without removing their wet socks or boots, the result frequently being loss of both feet. The treatment adopted was to relieve the fever of reaction, support the constitution, and allow the dead portions to separate from the living, assisting them by the means already described in gangrene from laceration or bruises, and subsequently detaching with great care such parts as were disorganised. This gangrene may, to a certain extent, have been brought about by a scorbutic taint, as the ulcers which remained were most difficult to heal.

In idiopathic gangrene, or that induced by constitutional causes, the rule is never to amputate until the line of separation has formed, and then to wait until the parts have ulcerated so deeply that there is no prospect of its extending further. During the process of separation the patient's health should be improved and prepared for the operation of amputation, which in general will consist in cutting through osseous, ligamentous, or tendinous structures. It may, however, be necessary to form a regular stump by amputation higher up or through the stump already formed, the flaps being designed according to circumstances.

*Bed sores*, a form of gangrene from pressure, which but too frequently comes under the notice of the army surgeon, arising from patients being obliged to lie for lengthened periods in the same position, after having undergone operations; or in the treatment of fractures of the lower extremities, probably without proper bedding, cleanliness, nursing, or fresh air, and in subjects already debilitated from exposure and want of proper nourishment.

\* 'Traité de Chirurgie d'Armée,' by L. Legouest.

These sores generally appear on the sacrum, the trochanters, elbows, shoulders, heels, and back of the head.

The surgeon should ever be on the watch for them, as, in very weak subjects, they give but little warning of their approach or presence.

When there is a probability of long confinement, and the case is likely to be attended with constant decubitus, every precaution should be adopted, such as keeping the parts dry, the bedclothes smooth, and pillows arranged from time to time so as to prevent pressure on any particular spot.

Water and air beds may be used with great advantage, but in warm climates are heating.

The skin may be hardened by the application of brandy, rectified spirits, solution of alum, tannin, tincture of iodine, collodion, or a solution of bichloride of mercury composed of two grains to one ounce of spirits of wine.

Sir William Fergusson recommends that the parts be defended with soap plaster, spread on felt; others recommend its being spread on isinglass

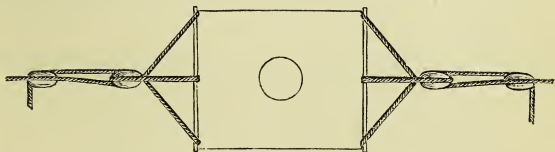


Fig. 114.

plaster. The writer has a strong objection to plasters as preventives for bed sores, as they are liable to wrinkle, cause irritation, and prevent the condition of the parts being seen.

When bed sores do occur, removal of pressure must be carried out by some means, which, on service in the field, requires ingenuity, as the usual mechanical contrivances found in permanent hospitals may not be present.

A sling for the more convenient treatment of bed sores has been designed by the author, which he used with advantage in cases where the sacrum and nates were severely implicated, and which may be applied in camp or permanent hospitals.

The sling consists of a strip of West of England canvas, 18 × 24 inches. At either end it is stitched on to pieces of strong wood about the diameter of the common office-ruler, which keeps the canvas expanded when under the patient, and forms means of fastening stays, which are spliced together and attached to three-inch blocks. These blocks have ropes passing through

them and through blocks of same size attached to poles or uprights (fig. 114), by which means the sling can be raised or lowered. A piece of canvas, round in shape, and four inches in diameter, is removed from the centre of the sling, through which the sores can be dressed or cleaned. In applying the sling, it is necessary to place a mattress doubled at one end under the patient's shoulders, the thin end extending to the loins. A pillow should be placed under the knees, and, except for dressing the sores, the patient should not be raised more than one inch off the bed.

For local application, numerous remedies have been recommended. Cleanliness should be the first consideration, and the removal of sloughs if any exist; after which soft poultices may be applied, which act as cushions as well, besides having other good qualities; these may be composed of fermenting materials, or sprinkled with charcoal.

Equal parts of castor oil and balsam copaiba may be applied; this, in the hands of the writer, has always been attended with success.

Balsam of Peru, either pure or diluted with the yolk of egg, spread on lint, is useful.

Warm astringent applications, such as catechu, myrrh, iodine, resin, have been spoken highly of.

The health of the patient must be carefully attended to, as, without improvement in it, the sores will not heal.

## TETANUS.

THERE are two varieties of this disease—the idiopathic and traumatic : the former originating from cold or damp, particularly if the body has been previously exposed to heat and perspiring ; and the latter from some kind of injury, in which exposure to cold may predispose to its attack, as occurred after the battle of Ferozepore and Chillianwallah, when the wounded were exposed during the cold nights, after very hard work during the day in a burning sun. It also occurred in Egypt under the same circumstances, as mentioned by Larrey ; and after the battle of Ticonderogo, when the wounded were exposed the whole night after the action, in open boats, upon Lake George.

The symptoms in both are exactly the same, but they may vary in degree.

The experience of army surgeons is, that tetanus may supervene on every description and in every stage of wounds, from the slightest to the most formidable, in the healthy and sloughing, the incised and lacerated, the most simple and the most complicated ; in all constitutions ; in the strong and robust, and in the feeble and debilitated. It is, however, more apt to occur in debilitated subjects when the nervous system is lowered. It is more common in hot than cold climates. It occurs in all states of the atmosphere, but is most common during sudden changes of the weather.

Missiles that have not been extracted appear to exercise some influence on the development of the disease.

Punctured wounds appear more liable to be followed by tetanus ; and wounds of the extremities more than wounds in the head, breast, or neck.

Hennen considers that exposure to different temperatures appears equally to predispose to it, and that the various forms of the disease are produced indiscriminately by similar causes.

Hamilton divides the causes of traumatic tetanus into predisposing and exciting ; the predisposing being mental depression, climacteric influences, such as excessive heat, sudden vicissitudes of weather, and especially a rapid change from hot to cold and damp weather—it is more frequent in spring and autumn than in summer or winter—exposure of a portion of the body to cold draughts of air, an irritable temperament, physical exhaustion, disorder of the stomach and bowels, a scorbutic taint.

The exciting causes are wounds, especially compound fractures, in which spiculæ of bone press upon nerve trunks ; wounds accompanied with un-



healthy suppuration, gangrenous sores, or those which from neglect are not kept properly cleaned ; laceration, contusion, partial division or ligature of a nerve.

Longmore considers that the most common cause appears to be local injuries to nerves, producing irritation along their course, and so leading to some morbid condition of the ganglionic portion of the motor tracts of the spinal cord.

In temperate climates the disease seldom supervenes before the fourth or fifth day. In hot climates it may appear sooner ; but it may take place at any period after the infliction of the injury, even after the wound has cicatrised.

Tetanus may be acute or chronic ; the former proving in general rapidly fatal, and the latter continuing for a considerable period. The further prolongation of the disease, the better prospects of recovery.

The disease is generally ushered in by a disturbed state of the digestive organs, with a feeling of malaise, a sense of weakness, and general depression ; stiffness or soreness about the jaw, face, and neck ; inability to swallow food or drink. As the disease advances, there is pain in the pit of the stomach, spasms of the voluntary muscles, the countenance assumes an aged and agonised expression, the angles of the mouth being drawn up (*risus sardonicus*). Cramps and pains will attack the muscles of the legs ; difficulty of breathing will set in with a loud sobbing from spasms of the diaphragm. The skin will be hot, the pulse quick, and perspiration profuse, with pungent smell. The mind in all probability will remain clear, but the sleeplessness will cause much distress.

The muscles of the trunk become affected, the body being sometimes bent back, forming an arch (*opisthotonos*), or to one side ; or the body may be straight, stiff, and rigid, with the belly drawn in and chest expanded ; or the body may be arched forward (*emprosthotonos*). There may be constipation, but the sufferer will have perfect control of the bladder. The voice will be weak from spasmodic contraction of the muscles of the chest and neck.

The temperature generally becomes very high, particularly immediately before death, which occurs from exhaustion.

The sufferer may have short intervals of relief, the spasm being again induced by a slight current of air passing over the body, by taking food or fluids, or by shifting position or bed-clothes.

It has long been a subject of intense interest and consideration to discover what will relieve an unfortunate sufferer from this terrible disease, and offer some hope of recovery.

Older surgeons appear to have been helpless even in being able to afford relief ; and in the present day it is generally admitted that, though cures may be established in chronic cases, the acute disease always proves fatal.

Hennen remarks : "Happy should I be could I afford anything satisfactory on this dreadful complaint; but, in truth, my observations have tended more to show me what I could *not* trust to, than what I could place the smallest reliance on, when the disease was fully formed;" and further on he says, "I have never been fortunate enough to cure a case of Acute Symptomatic Tetanus; in some instances of the Chronic species I have effected or witnessed relief." Compare these remarks, written fifty-five years ago, with what Mr. Erichsen now says: "Nothing can be more unsatisfactory than the treatment of the acute form of traumatic tetanus. In it all medicines are useless as curative agents; but though medicines are of no avail as means of cure, they may act as palliatives and afford relief to the patient."

The line of treatment must be local and constitutional, the former being with a view to removal of the irritation producing the disease. For this purpose, if there is a wound, it should be most carefully cleansed, and all extraneous substances, such as pieces of clothing, bullets, and splinters of bone, should be removed. If matter is pent up, it must be evacuated; and if the wound is inflamed, an endeavour should be made to bring it to a healthy state.

The tetanic symptoms having been induced by puncture or laceration of a nerve, Larrey recommended that it, the trunk, should be divided, and was successful in the treatment. This expedient has also been adopted by others, and with satisfactory results.

Mr. Liston recommends cutting down on the bone, with a  $\Lambda$ -shaped incision, above the seat of injury, cutting it off completely from the influence of the nerves.

Professor Fayrer, of Calcutta, mentions a case of tetanus caused by a wound of the hand, and relieved by section of the median nerve.

*Amputation of the injured limb* has been adopted, the better to remove all possible sources of irritation; this measure is not now advocated.

The remedies recommended for constitutional treatment are numerous, surgeons having tried them from time to time, probably affording relief in some cases, and being utterly worthless in others. The following may be mentioned: opium, blood-letting, cold and warm baths, cold affusion, hot-air baths, ice to the spine, bromide of ammonium, galvanism, bark, wine, spirits, mercury, purgatives, foxglove, tobacco, Indian hemp, musk, Prussic acid, iron, belladonna, turpentine, strychnine, woorali, ether, chloroform chloral, Calabar bean.

*A case of tetanus having occurred*, the bowels should first be relieved by a large enema with turpentine, after which perfect quietness, in a darkened room free from noise or currents of air, must be insisted upon, being the best means of preventing the approach of spasm. The use of the ice-bag along

the spine, as recommended by Todd, has afforded relief in allaying the spinal irritation, but is a great depressant. Chloroform has been extensively used, but without any permanent benefit. Hamilton remarks on this remedy, that "it has been tried very largely during the past few years, and, so far as we can learn, almost universally by our army surgeons, but not with a success which in our judgment would warrant its continuance, or, to say the least, its substitution for opium or morphine."\* After enumerating the various remedies proposed, he goes on to say: "In our opinion, but few of these remedies are entitled to any special confidence; by far the largest mass of testimony having accumulated in favour of nutritious food, tonics, stimulants, and opiates, the latter of which, if employed at all, must be given in the most liberal and persevering manner; in some cases both by the mouth and by the rectum, or by the endemic method."

With regard to sedative and antispasmodic agents, Erichsen considers they are of no use whatever in acute traumatic tetanus. "I have," he says, "seen many drugs of this kind employed without producing any effect in lessening the violence of the convulsion. In most cases, however, the inhalation of chloroform, or the administration of chloral, materially lessens their severity, and gives the patient at least temporary ease."†

Sir W. Fergusson observes: "The free use of purgatives by the mouth and as clysters, and then the use of opiates and antispasmodics, are the means which I should be the most inclined to at first; and by narrowly watching the symptoms, some hint might be gleaned as to whether these should be persisted in or abandoned. In such cases as I have seen since the introduction of anæsthesia that influence has seemed to me the most powerful for temporary benefit. I have never known chloroform fail to take off the spasm in the earlier stages of the disease."‡

The Calabar bean has been used of late years with some success, but, like all other medicines, it has failed in many hands. It is a great depressant, and with it large quantities of stimulants should be given, as well as beef-tea, as long as the patient will take them, or by enemata. The bean should be given frequently, and until the pupil is completely contracted.

Deputy Surgeon-General Gordon reports, that during the siege of Paris M. Demarquay saved several individuals who had manifested the early symptoms in the form of trismus, by means of very hot air-baths, followed by the injection of morphine under the skin.

The results in the developed cases seem to have been unfavourable.§

Professor Fayrer records two cases of traumatic tetanus treated and

\* Hamilton's 'Military Surgery,' p. 600.

† Erichsen's 'Science and Art of Surgery,' vol. i., p. 635.

‡ 'System of Practical Surgery,' by Sir William Fergusson, p. 44.

§ 'Lessons in Hygiene and Surgery,' p. 179.

cured by opium smoking and internal administration of chloroform and hemp. Both patients were Hindoos. The average quantity of opium-goolie smoked daily by one patient was eighty-four grains. The chloroform and hemp were administered according to the following prescription :—

R Chloroform, ℥x.  
Ext. of hemp, gr. i.  
Mucilage, ℥i.  
Camphor Mixt. ʒss. Every six hours.\*

Stimulants and nourishment appear to give more prospects of success than any other means, and with the use of chloroform to lessen the spasms, perfect rest, quietness, and freedom from currents of air, the sufferer may withstand the exhaustion in the chronic form of the disease. On this line of treatment Sir T. Watson remarks : “In all cases, there being no special indication to the contrary, I should be more disposed to administer wine in large quantities and nutriment than any particular drug.” These remarks are most significant and important.

\* Fayrer's ‘Clinical Surgery,’ p. 531.

## HOSPITAL GANGRENE.

“PUTRID ULCER,” “Phagedæna Gangrenosa,” “Sloughing Ulcer,” “Pourriture d’Hôpital.”

Hennen attributes hospital gangrene to bad air, want of cleanliness and ventilation, also to intemperance. Guthrie says, “It originates only in badly ventilated hospitals, crowded with wounded men, among and around whom cleanliness has not been too well observed.”

Legouest, after pointing out the usual unsanitary conditions which are liable to promote this disease, remarks : “Yet we have observed it in the most healthy hospitals, in well-ventilated corridors, in churches, in barracks, and even under canvas, and that under the most strict hygienic observances. Can it be averted, while large numbers of wounded are collected together in the same building, and it may be propagated through the atmosphere, as an epidemic, or by contagion by sponges, charpie, and dressings?”

The experience of Hamilton appears to coincide very much with that of Legouest, that notwithstanding the most careful sanitary arrangements and healthy position, protracted epidemics of the disease have been inaugurated. He gives as examples the epidemics which occurred at De Camp and McDougall General Hospitals during the summer of 1863.

Taylor, who had great experience of the disease in India, was unable to determine satisfactorily to himself whether it be a local or constitutional affection. “I am inclined,” he says, “to place it in the former category ; and there is no doubt whatever that the essential means of treatment are local.”

Blackadder is of opinion that at first it is a purely local affection, and that the constitutional symptoms do not make their appearance before the third, fourth, or, sometimes, not till the eleventh, day.

Hennen describes the disease, as it occurred at Bilbao, in the following words :—“Let us suppose that our wounded have all been going on well for several days, when suddenly one of our most promising patients complains of severe pain in the head and eyes, a particular tightness about the forehead, want of sleep, and loss of appetite, and that these feelings are accompanied with quickness of pulse and other symptoms of fever ; his wound, which had been healthy and granulating, at once becomes tumid, dry, and painful, losing its florid colour, and assuming a dry and glassy coat. This is a description of the first stage of our Bilbao hospital gangrene ; and if a brisk emetic was now exhibited, a surgeon not aware of the disease that

was about to form, would be astonished at the amelioration of the sore, and the unusual quantity of bile and indigested matter evacuated by vomiting. If, however, this incipient stage was overlooked, the febrile symptoms very soon became aggravated; the skin around the sore assumed a highly florid colour, which shortly became darker, then bluish, and at last black, with a disposition to vesicate; while the rest of the limb betrayed a tendency to oedema. All these threatening appearances occurred within twenty-four hours; and at this period also the wound, particularly if it was situated on a muscular part of the thigh, buttock, or calf of the leg, whatever might have been its original shape, soon assumed the Circular Form. The sore now acquired hard, prominent, ragged edges, giving it a cup-like appearance, with particular points of the lip of a dirty-yellow hue, while the bottom of the cavity was lined with a flabby blackish slough.

"This rapid progress and circular form of the ulcer were highly characteristic of hospital gangrene, and obtained almost universally, in every wound infected with it, wherever situated.

"The gangrene still advancing, fresh sloughs were rapidly formed, the increasing cup-like cavity was filled up and overtopped by them, and the erysipelatous livor and vesication of the surrounding skin gained ground, while chains of inflamed lymphatics could be traced from the sores to the adjoining glands, these exciting inflammation and suppuration, which often furnished a new nidus for gangrene. The face of the sufferer assumed a ghastly, anxious appearance; his eyes became haggard, and deeply tinged with bile, his tongue loaded with a brown or blackish fur, his appetite entirely failed him, and his pulse was considerably sunk in strength, and proportionally accelerated. In this stage the weakness and irritability of the patient was such, that the slightest change of posture, or the most delicate examination of the sore, put him to torture, increased by his inability to steady the limb, which, if moved at all from the bed, was seized with tremors and spasmodic twitches."

Mr. Hennen speaks of the torture of this disease as something terrible: "Men," he says, "who had borne amputation without a groan, shrunk at the washing of their sores, and shuddered at the sight of a dead comrade, or even on hearing the report of his death, instantly predicting their own dissolution, and sinking into sullen despair. The third and last stage was now fast approaching. The surface of the sore was constantly covered with a bloody oozing, and, on lifting up the edge of the flabby slough, the probe was tinged with dark-coloured grumous blood, with which also its track became immediately filled; repeated and copious venous bleedings now came on, which rapidly sunk the patient; the sloughs, whether falling off spontaneously, or detached by art, were quickly succeeded by others, and discovered on their removal small thickly studded specks of arterial blood. At length an artery sprung, which, in the attempt to secure it,

most probably burst under the ligature. Incessant retchings soon came on, and, with coma, involuntary stools, and hiccup, closed the scene. Often, however, the patient survived this acute state of the disease, and sunk under severe irritation, absorption of putrid matter, and extensive loss of substance, without any other symptoms than those of hectic fever, arising from other sources.\*

The muscles may become extensively exposed or destroyed, leaving a cavity with tendons, vessels, and nerves stretched across from side to side. The bones sometimes become denuded of periosteum, or are attacked with the disease.

Blackadder, who records the disease as it appeared in himself, says it commenced with local symptoms. He wounded himself accidentally with a scalpel. In the course of about sixty hours the wound became inflamed, and he was occasionally attracted to it by a smart, stinging sensation, which ultimately extended a considerable way up the arm. On the fourth day the inflammation had increased, and the stinging sensation was almost constant; headaches, nausea, and general indisposition followed, with frequent chills, which increased very much towards evening, but which, with other symptoms, were considerably relieved by the use of neutral salts, the pediluvium, and warm diluents. A vesicle, having a depression in its centre, and having a watery fluid of a livid colour, was now forming upon a hard and elevated base; the surrounding integuments became tumified of an anserine appearance, and extremely sensitive to the touch; at about the distance of the fourth of an inch from the base of the tumour, a distinct areola of a bluish-red colour made its appearance, and remained visible for several days. At this period circumstances rendered it necessary for him to be exposed to wet, to undergo considerable fatigue, and immediately afterwards to travel to a considerable distance. The inflammation, however, gradually subsided, but the stinging, accompanied by the burning sensation, still continued; and the sore had no disposition to heal, yet it did not enlarge externally, but was disposed to burrow under the integuments.

Mr. Taylor, late of H. B. M. 29th Regiment, experienced an epidemic at Ferozepore, in India. He remarks: "First, I could tell, by the peculiar dark florid countenance of the patient, that his wound had taken on the gangrenous affection; yet I cannot say that there was in these cases any marked inflammatory fever. In many cases the disease seemed purely local; but in the great majority there was certainly much feverish constitutional disturbance accompanying the local affection, and often preceding it."

There appears to be some difference of opinion among surgeons as to whether the disease has a local or constitutional origin. In some

\* Hennen's 'Observations on some points in Military Surgery,' p. 233.



epidemics it set in with febrile symptoms and general constitutional disturbance, and in others the symptoms were entirely local, or very slight constitutional disturbance. There is no doubt as to its highly contagious and infectious character, that it is capable of being transmitted by nurses, clothing, dressings, instruments, sponges, and atmosphere; that it attacks wounds in every stage and condition; that it can be inoculated; that it is generally caused by overcrowding of wounded, bad ventilation, want of cleanliness, privation, intemperance, and previous exposure, but that there are occasions when it occurs in the form of an epidemic, notwithstanding the most rigid and careful sanitary regulations; that it appears in all climates, in all seasons and weather, the wet and moist or very cold being most favourable to its production; and, finally, that there may be predisposing causes, such as patients having a scorbutic taint, an enfeebled constitution, or a nervous system depressed by the effects of a severe operation, or administration of chloroform.

The symptoms in every feature of the disease have been so well described by Hennen, Blackadder, and Taylor, in the foregoing remarks, that it is scarcely necessary to repeat them here.

With regard to the treatment of this formidable disease, no specific has as yet been laid down for its cure, but each medical officer who has had the misfortune to meet with it has recommended such treatment as he found most successful.

The first consideration of the surgeon will be to try and prevent a further spread of the disease, by removal of the infected patient from among the other wounded, and by prophylactic measures, such as the use of disinfectants with all suppurating wounds, plenty of fresh air, strict sanitary arrangements in and about the hospital buildings, destruction by fire of all dressings, the total disuse of sponges, cleanliness among the patients, attendants, clothing and bedding, evacuation of infected buildings, and fumigation of them.

The sufferer will have to be considered with respect to local and constitutional symptoms. For the former numerous applications have been tried and recommended, which, as some writers remark, may agree with the ulcer for a day or two, then become inert or hurtful. The following are some of these:—Strong mineral acids, arsenic, nitrate of silver, turpentine, creasote, permanganate of potash, camphor, antiseptics, iodine, perchloride and sulphate of iron, carbolic acid, irrigation, leeches; also the bromides and actual cautery, as recommended by Pouteau, Delpech, and Dupuytren. Of late years bromine and the actual cautery have afforded the most satisfactory results.

Mr. A. E. Baker, of Dublin, who had some experience of the disease during the Franco-German War of 1870-71, while aiding the sick and wounded, says the more active treatment employed with a view to arrest

the ravages of the disease, consisted in the application of various caustics ; thus liquor ferri sesquichloridi, chloride of zinc, acid nitrate of mercury, nitric acid, and the actual cautery, were all made use of ; none of them, however, seemed to be of any service except the last ; indeed, after the application of the chloride of zinc, the extent of the wounded surface seemed to increase more rapidly than before.

In the application of the actual cautery, he considers that, if only properly applied, it would always put a stop to the morbid action ; but to bring this about care had to be taken to let the effect of the hot irons extend beyond the tissues already the seat of the affection, and into the healthy structures further off.\*

Legouest considers the actual cautery most useful in severe cases of hospital gangrene. "Unfortunately," he says, "its use is not always practicable. It requires a steady hand and great determination to place the iron in the neighbourhood of the large vessels, nerves, tendons, articulating surfaces, which sometimes render its application dangerous."

Hamilton, after mentioning the usual local remedies, remarks that from his own experience he is convinced of the superiority of bromine over any other preparations, as a local application. Dr. M. Goldsmith, U.S.V., introduced this agent ; and, for its application, Hamilton gives the following useful and practical hints :—

1. The use of an anæsthetic, if the operation promises to be a long and tedious one, Mr. Hamilton objects to, on account of its depressing influence as a predisposing cause of the disease.

2. The wound should be thoroughly cleansed with warm water and soap, and freed from all dead and gangrenous tissue by means of scalpel or scissors, aided by the forceps. The healthy tissue should be denuded as far as possible.

3. The surface to be treated should be thoroughly freed from moisture, the pouches and recesses not being omitted.

4. If the pure bromine be used, a small glass pipette should be introduced into the bottle containing the liquid, and then being carried to the surface to be cauterised, thoroughly applied to every part. Cavities may be reached by means of small portions of lint dipped in the bromine, and then carried, by means of an eye probe, or a pair of forceps, into the desired positions.

5. It is frequently beneficial to paint the surrounding tissues, to the extent of an inch, perhaps, with a solution of the bromine ; using a drachm of the bromine to four ounces of water.

6. Immediately after the application of the bromine an emollient poultice should be applied. This tends to allay any undue irritation, and favours the speedy evolution of the slough.

\* 'The Medical Press and Circular,' March, 1873, p. 267.

He recommends diluted solution of the pure bromine, in the proportion of a drachm to eight ounces of water for unhealthy-looking wounds.\*

*Constitutional Treatment.*—Venesection was at one time strongly recommended, but it has fallen into disfavour, the typhoid type of the disease, and the demand for support, causing surgeons to be adverse to such practice.

Hennen used the following treatment in the epidemic at Bilbao. On first invasion of the disease, as well as on all occasions of threatened relapse, that the *primæ viæ* be well cleared by full emetics, followed by purgatives, and that the state of the bowels and skin be carefully attended to throughout its whole progress. For local treatment, he recommends that the sores be covered with large fermenting poultices, and if there be great tension and inflammation of the limb, cloth dipped in saturnine solutions should be applied. For irritable sores, tincture of opium, camphor dissolved in oil, or paste of camphor and opium; when the factor is great, charcoal, either alone or mixed with bark or camphor.

Blackadder recommends the use of Fowler's solution of arsenic as an escharotic: he found it answered well in arresting the progress of the disease at Passages and at Antwerp.

Mr. Taylor is in favour of the application of nitric acid, applied with the blunt end of a probe, so that it not only destroys the cuticle, but kills the *cutis vera* and probably cellular membrane underneath.

Gross considers the great constitutional remedy to be opium, either in substance or in the form of morphia. It should be given in large doses generally, not less than from two to four grains every six or eight hours, in union with a diaphoretic, as ipecacuanha, tartar emetic, or the neutral mixture.

The local treatment, he says, should be of the most gentle and soothing character. Vesicles should be promptly opened, and the whole surface pencilled over with a weak solution of iodine, followed by the warm or cold water dressing, containing a large supply of acetate of lead and opium, a cloth dipped in the solution being constantly kept upon the part. If an eschar has formed, the adjacent structures should be freely rubbed with the solid nitrate of silver, and as soon as the slough has dropped off, the bottom of the sore should be thoroughly mopped with a weak solution of acid nitrate of mercury, nitric acid, or perchloride of iron, with the view of changing its action. If the tendency to spread is very great, and there is at the same time excessive pain with a feeling of tension, scarifications and incisions must be practised in the same manner, and with the same object, as in Erysipelas.

Amputation during the progress of the disease has been attended by the

\* Hamilton's 'Military Surgery,' p. 577.

most unsatisfactory consequences. Hennen considers that it is most improper to attempt to operate before the fever has abated, and the sloughs begin naturally to detach themselves. To give amputation every possible chance of success, separation is indispensable ; the skin detached as little as possible from the muscles, and the bleeding from the small vessels restrained by pressure and dossils of lint dipped in oil of turpentine, while the ligatures on the large trunks should have both ends cut short.\*

Hamilton is of opinion that amputations performed during the progress of the disease are, as a general rule, disastrous, for the following reasons :—The patient is in no condition to rally from the effects of the operation, and the stump is exceedingly liable to be attacked with the disease for the arrest of which the operation was performed.

\* Hennen's 'Observations on Military Surgery,' p. 249.

ERYSIPELAS.

THIS formidable disease is the result of blood poisoning, which frequently attacks sick and wounded in civil and military hospitals, and seriously complicates surgical operations and injuries.

It may occur sporadically, without any wound, lesion, or injury, in persons exposed to cold whose health is somewhat deranged, or in a wounded person predisposed to the disease, or by contagion or infection through contamination by dressings, attendants' fingers or clothes. It may occur as an epidemic from some unknown atmospheric influence, by over-crowding of hospitals, imperfect ventilation, noxious effluvia, or want of proper sanitation; by inoculation with putrescent animal matters in patients whose constitutions are already weak and debilitated.

The exciting causes may be local injury, wounds of any kind, contusions, fractures, sprains, lacerations, wounds of extremities, scalp wounds, and exposure to cold draughts.

Lacerated and punctured wounds are more liable to its attacks than clean incised wounds; injuries about the head, hands, and knee appear especially so.

External erysipelas is generally arranged in three divisions: "1. The cutaneous; 2. The cellulo-cutaneous, or phlegmonous; and 3. The cellular or diffuse inflammation of the cellular tissue."

The first, or *cutaneous*, is of the mildest form, and is known by redness of the skin, which disappears momentarily on pressure, with severe burning or smarting pains, and swelling from effusion into the cellular tissue.

The intensity of the redness, which is the characteristic symptom of this disease, will depend very much upon the state of health of the patient, as in debilitated subjects it takes on more of a yellowish tint. In this form miliarial vesicles, or large blebs, may appear about the third day, when they break and crust.

The constitutional symptoms will be rigors, alternate chills and flushes, followed by headache, nausea, hot skin, quick pulse, coated tongue, constipation, sometimes diarrhœa, and, in severe cases, delirium at night.

This form, called inflammatory erythema, frequently attacks distant parts of the body, subsiding in the part first affected, when it is known as erratic; or it may extend rapidly over the cutaneous surface. In case there is a wound or granulating surface, it takes on an unhealthy action: the edges or surface become flabby, and covered with thin serum, instead of

healthy pus ; granulations become pale and more or less absorbed, or the wound may become dry and the edges swollen ; and when there is a tendency in a wound to unite, the adhesion gives way.

In the second, or *cellulo-cutaneous* or *phlegmonous*, the redness is deeper, sometimes even dusky or purple ; inflammation extends deeper into the tissues, and, if neglected, will terminate in diffuse suppuration or sloughing of them, extending to the intermuscular septa, the sheaths of the vessels and tendons, or the tendons themselves ; the swelling is much greater, is hard and brawny, pitting on pressure ; the pain is severe and throbbing.

The constitutional symptoms will commence as in the cutaneous form, but more intensified ; they will, however, soon assume a typhoid character if the patient is weak and has been subjected to much privation and exposure ; but if under the influence of proper treatment and the patient is strong, the inflammation will subside and the disease will gradually disappear.

In the third, or *cellulo-cutaneous* or *diffuse inflammation*, the disease affects the areolar membrane primarily, and the skin secondarily. It is characterized by the same local and constitutional signs and symptoms as phlegmonous erysipelas, but more intense. As the disease advances, the skin becomes mottled, livid in patches, and rapidly runs into blackish sloughs. It may extend to any distance up a limb, and even invade the trunk ; it will also affect the sheaths of the vessels and tendons, and the tendons themselves. The joints may also become involved, and bones be denuded of periosteum and become necrosed.


The treatment which should be adopted in the first form must be to clear out the stomach and bowels by an ipecacuanha emetic and mercurial purge. Then the condition of the patient as regards constitution, age, and previous habits will be the best guide. Should he be young and robust, spare diet and diaphoretics, with the local application of fomentations, will be sufficient ; but in men who have been exposed to privations, who may be debilitated from any cause, when the disease assumes a lower type, ammonia, bark, camphor, tincture of the sesquichloride of iron, wine, and nutritious diet should be administered. The tincture of iron and also quinine have been found most beneficial, acting speedily.

The local abstraction of blood by leeches, cupping, or punctures is not advocated by modern surgeons. In the *cellulo-cutaneous* form, the object is to prevent the inflammation running into a state of gangrene ; for this purpose purgatives and antimonial diaphoretics should be administered in the first instance. If the disease advance to suppuration or gangrene, it will be necessary to support the patient by tonics, stimulants, and generous diet. The parts should be kept at rest and elevated. Poultices and fomentations, with chamomile or poppy-head applications, may check the disease ; but if not successful, and it advance to suppuration or gangrene, it will be necessary to make free incisions through the cellular tissue into the

fascia, which will allow the blood and effused serum to pass off; poultices or fomentations must then be applied, and as sloughing and suppuration take place, further incisions must be made to allow of their evacuation.

Dr. Copeland Hutcheson recommends incisions about  $1\frac{1}{2}$  inch in length and 2 or 3 inches apart in a longitudinal direction, cutting into the fascia and beyond it, according to the extent of the inflammation.

Sir W. Laurence recommends one long incision, which has been objected to by many surgeons on account of such a wound inflicting a severe shock on the system from hæmorrhage, and the one incision not relieving the tension.

South advocates incisions arranged in fours , so as to enclose a diamond-shaped space, which relieves the tension.

Erichsen recommends that the incisions should be of limited extent, from two to three inches in length; at most they should not extend deeper than into the gelatinous-looking subcutaneous areolar tissue, unless it happens that the disease has extended beneath the fascia, when they may also be carried through it.

In the after-treatment the limb should be well supported by soap plaster from the points of the toes or hands up to the limb, apertures being made in the strips opposite the wounds to admit of free discharge. The limb should be enveloped with cotton wool and surrounded with a bandage.

Burrowing under the skin must be prevented by following up sinuses and dividing unhealthy vascular connections. Tissues in a state of slough or gangrene will have to be gently removed, as their presence may produce most serious consequences by their decomposed condition.

In the treatment of cellular erysipelas support may be required from the first. The local treatment is the same as in phlegmonous erysipelas.

Cold applications should never be used in any form of erysipelas.

The after-consequences of cellulö-cutaneous and cellular erysipelas may be most troublesome, the inflammation having extended to the sheaths of the tendons and the tendons themselves. There may be stiffness of joints and contraction, as frequently occurs, in the fingers, wrist, elbow, and knee, where these tendons become so completely matted together that the motions may be seriously impaired, if not destroyed, or the joints or bones may be so diseased as to require amputation of the limb.

The army surgeon is most likely to meet with diffuse inflammation after shell wounds, or in wounds from splinters of wood. Soldiers doing duty in supply departments and employed in the slaughtering of animals are very liable to the disease.

On the first appearance of erysipelas the infected individual should be removed from the vicinity of the sick or wounded, or, better still, the sick



or wounded should be removed from the vicinity of the erysipelas; the latter in most cases being utterly impracticable, the most the surgeon can do is to isolate the sufferer and prevent all communication between him and the other patients, hygienic measures being at the same time enforced.

### PHLEBITIS.

INFLAMMATION of the veins may be divided into two kinds—idiopathic and traumatic; and these again into adhesive, suppurative, and diffuse phlebitis.

The *idiopathic* form is generally of adhesive nature arising from exposure to cold and wet.

The *traumatic*, or that which the army surgeon has most frequently to contend with, may arise from a vein being wounded, and the wound not being accurately closed, or when disturbed irritation is set up, and pus allowed to enter the vessel; or it may arise from the application of a ligature, or from any description of wound to the veins (especially in unhealthy subjects and at particular seasons) which predisposes to low forms of inflammation, giving rise to symptoms of most serious nature, and not unfrequently ending in blood poisoning, pyæmia, diffuse erysipelas, suppuration.

In the idiopathic form the larger veins are generally affected, the disease being localized and limited; but in the traumatic it may occur in any vein that is wounded, the inflammation being more extended.

In both, the disease may commence with the adhesive form, but in the latter it generally runs on to suppuration.

The symptoms: An enlargement of the vein, which becomes hard, swollen, painful, and knobbed, having a reddish-purple colour; stiffness, and severe twitches through the limb, with hard, tense feel, and pitting on pressure, from the state of œdema. Much stress has been laid on this latter symptom by some authorities as a diagnostic sign in deep-seated, adhesive phlebitis, when the vein cannot be felt, and may be the first symptom noticed. "The œdema may give rise to a hard, white, and tense condition of the limb, which pits on pressure, though in some cases the hardness is too great for this."\*

These symptoms may be relieved under suitable treatment; but should the disease advance to suppuration, there will be high fever, shivering, and the usual symptoms denoting that it has taken place, or is about to do so.

The treatment at first will consist in most perfect rest; the application of leeches along the course of inflamed vessel; warm applications, such as fomentations or poultices; and, when the patient can bear it, the administration of saline purgatives. If, on the other hand, there is depression, it

\* Erichsen's 'Science and Art of Surgery,' vol. i., p. 641.

will be necessary to administer ammonia, bark, and stimulants. When the œdema and hardness of the limb continue, salt and nitre poultices have been recommended for their removal ; also blisters, or pressure with an elastic roller. In suppurative phlebitis, local abscesses may form, which run their course like other abscesses, and are bound and limited by inflammation, so preventing their contents entering the vessels and mingling with the current of the blood ; but should the pus by any means enter the circulation, the result will in all probability be most serious, and they should be opened without delay.

Diffuse phlebitis is generally a low form of erysipelas, which commences as an ordinary case of inflammation of the veins, but soon takes on alarming symptoms, characterized by extreme prostration, dry brown tongue, fluttering pulse, sordes on the teeth and mouth, diarrhœa, delirium, and death.

Such a case would require the same line of treatment as that recommended for diffuse erysipelas of the worst form.

## PYÆMIA.

OLDER surgeons hardly recognised this disease, although correct descriptions of it are given by them under the headings of "purulent deposits," "consecutive pneumonia," "consecutive fever."

Professor Aitken defines the disease as "a febrile affection, generally sequent on wounds, suppurative inflammation of bone, on surgical operations, resulting in the formation of secondary abscesses in the internal visceral organs (most frequently in the lungs, liver, kidneys, spleen, and brain), and also in joints and connective tissue sometimes, but not necessarily, associated with phlebitis or embolism." The disease has lately been described under the various names of pyogenic fever, purulent infection, putrid fever, surgical fever, purulent absorption, septicæmia.\*

It is a disease often originating in contagion, or by inoculation conveyed by nurses, clothing, fingers of attendants, or dressing. It may appear spontaneously after acute inflammation, involving large portions of bone, or in compound fractures, accompanied by extensive laceration of the soft parts; by modes of dressing wounds preventing union by the first intention, and promoting suppuration.

Those suffering from severe injuries, wounds, or having undergone surgical operations and suppurative inflammation involving bones, veins, or joints, have the reputation of being most liable to it, especially in large hospitals, where there is over-crowding of patients with suppurating wounds, and in damp, moist weather, bad ventilation, and defective sanitary arrangements. Notwithstanding all these circumstances, which it is said cause the disease, it has been lately pointed out by Mr Prescott Hewett that pyæmia occurs also in cases even when placed under the most favourable conditions—perfect isolation, large airy rooms in the country, with plenty of fresh air, and in every way well-cared for. Pyæmia appears, too, at times to be connected with atmospheric conditions; several cases occurring without any apparent cause, at or about the same period, in different places.†

Surgeon Sanford Moore, 4th Dragoon Guards, who had considerable experience when aiding the sick and wounded during the Franco-German war, 1870-71, remarks: "Pyæmia and hospital gangrene proved as great

\* Aitken's 'Science and Practice of Medicine,' vol. i., p. 781.

† Mr. Prescott Hewett's Address, 'British Medical Journal,' January 31st, 1874, p. 131.

scourges as ever in the hospitals. It seemed extraordinary how these diseases appeared in some buildings and not in others, although both apparently presented the same conditions for attracting the disease. Nor does the supposition of superior hygienic arrangements explain their absence from some buildings; for a very dirty building, with patients huddled together in small rooms, their personal cleanliness entirely neglected, and each man with one or more profusely suppurating wounds, was given over to our ambulance in January last, and in this building there had been no pyæmia or gangrene, although it had been occupied by a still greater number of wounded for a month back."

Mr. Moore remarked that the diseases do not occur in hospital buildings until they have been occupied for at least ten days. He has not seen the diseases occur in a room for only one patient unless it was previously occupied by wounded. Nor has he seen them occur among patients in the upper stories of a house. A room once poisoned, no disinfection or white-washing seems to be sufficient to drive away the poison immediately, for the remaining patients placed in the room speedily become pyæmic also; and men with slight as well as severe wounds take pyæmia.\*

The following conditions have the credit of favouring the occurrence of the disease: debility attending convalescence after acute disease, intemperate habits, shock, hæmorrhage, nervous depression, chronic venereal disease, and exposure to transport of wounded, especially of those suffering from compound fracture of long bones; on the other hand, the most healthy have been attacked by it.

"The attack is usually very sudden, coming on generally between the tenth and twentieth days after receipt of injury, and is marked by severe rigor, followed by profuse perspiration, which will in all probability leave the patient apparently well, but will recur in a day or so, producing great depression, the pulse becoming feeble, rapid, or variable, often intermittent, temperature high. The rigor may be preceded by secondary hæmorrhage, described as parenchymatous hæmorrhage, characterized by general oozing from the surface of wound or stump.

"The sufferer may be attacked with cough, with or without expectoration, pleurisy, pneumonia, bronchitis, by peritonitis, pericarditis, or effusion in the head; but these complications may be entirely absent, or exist separately. The appetite disappears, the tongue becomes dry and brown, nausea, vomiting, and diarrhœa supervene, countenance becomes yellow or jaundiced, delirium sets in at night. The perspirations are still more profuse and exhausting, preceded by severe rigors; abscesses rapidly form in the joints, or among the various tissues of the body; these are of a widely-spread character, and very insidious, as they often occur without

\* 'Lancet,' April 8th, 1871, p. 477.

any local signs (the pus sometimes infiltrating the cellular tissue and muscles of a trunk to a great extent), and are most frequently met with in the axilla in the groin, back, iliac fossa, thigh and calf of the leg, giving rise to much suffering and exhaustion, from which the patient rapidly sinks. The disease may be at first mistaken for ague, rheumatism, or typhoid fever, but the continued rigors, followed by profuse perspirations, exhaustion, and suppuration, will soon declare the true nature of the disease."

The prognosis of the disease is most unfavourable. It is usually fatal; mild cases may recover, but when the disease is acute, when the rigors quickly follow one another, when the pulse is unsteady, the temperature high, the patient restless, the disease will in all probability prove rapidly fatal.

*Treatment.*—An endeavour should be made to purify the blood, and keep up the strength of the patient. The first indication must be done through change of air, strict cleanliness, good ventilation, administration of such remedies as will obviate the contamination of the blood. If the tongue is foul, and there appears to be hepatic congestion, calomel, followed by a purgative, should be given at once; this may be followed by the administration of the chlorate of potash, and some of the mineral acids, such as hydrochloric acid and nitro-muriatic acid. Professor Polli suggests such agents as will prevent the process of vinous fermentation going on in the blood, caused by the introduction of septic poison: these are sulphurous acid in combination with either soda, potash, magnesia, or lime, given in large doses.\*

The second indication may be carried out by giving brandy, wine, ammonia, bark, quinine, and nutritious diet; above all, hygienic measures must be strictly enforced as far as possible, which may be a difficult point to attend to, when the accommodation may be limited, the weather inclement, and no means of preventing overcrowding. The surgeon should keep in view the experience obtained during the war of 1870-71, when it was observed that pyæmia occurred most frequently in permanent buildings; next in frequency in huts, and last of all in tents. Pure air is of the greatest importance, and one must ever remember the remarks of Sir J. Paget, who declares that *the few patients whom he had known to recover from the disease owed their lives to being kept in a current of fresh air.*

Mr. Jessop, of Leeds, recommends that when pus forms in joints, it be removed with the pneumatic aspirator. He records two cases in which the result was satisfactory, the recovery being complete and rapid.

The primary lesion should be kept clean, cool, and disinfectants applied.

\* Mr. W. MacCormack, in referring to Professor Polli's antizymotic treatment, says: "It appeared to me to do a good deal of harm, and never much, if any, good; diarrhoea was induced by it, as well as vomiting."—"Recollections of an Ambulance Surgeon," p. 103.

Abscesses frequently occur in the neighbourhood of the lesion connected with injured bone ; these should be searched for and evacuated.

The cauterization of superficial veins on the proximal side of the diseased part, with a view to prevent the further entrance of poisonous matter into the blood, has been suggested.

## SEPTICÆMIA.

THIS disease has been described by some authors as being one and the same disease as pyæmia, and by others as being of the same group, having definite and distinct characteristic symptoms. There is no doubt that it bears much resemblance to it in its origin and results, but its progress differs materially in many points. M. Verneuil holds that all surgical fevers are so many different forms of septicæmia ; he believes that the disease may be developed spontaneously from decomposing organic matter in the surface of the wound. The poison thus created he calls *sepsine*, and he thinks that having been generated in a wound, it is inoculable in infinitesimal doses, and acts as a *ferment*, producing the disease septicæmia.\*

M. Gosselin maintains that septicæmia only arises from the introduction of a specific poison from without, through the wound surface, and so into the blood.†

Mr. Wyatt, who appears to have taken much trouble during the siege of Paris, 1870-71, to investigate the cause of this disease, designates it as a rapid generation of gaseous products from degeneration of tissues of the wounded limb, which, he says, was generally one of the lower extremities, the result being invariably fatal, and the duration of life from the date of the wound limited to about six days. He was unable to discover any lesion of artery or vein which might have been the cause of the disease. He, however, found laceration of the sciatic nerve, but does not venture to offer any explanation of the circumstances as provocative of the peculiar symptoms of the affection from defective nervous energy, simply recording the condition for future inquiry.‡

"Septicæmia is frequently associated with, or rather the sequel of, thrombosis, embolism, and phlebitis, arising probably in these morbid conditions from softening, breaking-up, putrefaction, and absorption of coagula ; or it may occur in connection with gangrenous osteo-myelitis and osteo-phlebitis. The symptoms are swelling and discoloration of the affected limb, œdema, from infiltration, which pits on pressure."

There are high fever and temperature at the outset, not preceded as a rule by rigor, or followed by profuse perspiration ; and if these do occur, they

\* Gordon's 'Lessons on Hygiene and Surgery,' p. 198.

† Ibid., p. 198.

‡ 'Report on Franco-German War, 1870-71,' by Surgeon-Major Wyatt, p. 18.

seldom recur during the progress of the disease. The skin is dry, no jaundice, but great prostration, with a temperature, as the disease advances, lower than the normal standard. Abscesses do not generally form in the viscera or joints.

The treatment will be the same as in pyæmia. An endeavour should be made to try and eliminate the poison from the blood, by the administration of antiseptics, supporting the constitution with good wholesome diet and stimulants, attention being paid to cleanliness and pure air.

Warmth, in the form of fomentation or poultices, should be applied to the injured part.



## OSTEO-MYELITIS.

INFLAMMATION of the medullary membrane may occur in an acute or chronic form, the former being most likely to be met with in warfare as the result of gun-shot injuries or amputation. It may, however, as Professor Fayrer remarks, have its origin in any wound, injury, or contusion of the bone, or of its periosteum or medullary membrane; sudden extremes of heat or cold, constitutional vice, such as syphilitic or strumous deposits of bone, or necrosis of the exterior extending inwards, and so causing mischief there. He is at the same time unable to explain why it should occur when the healthy condition and vigorous granulation of the soft parts of the same limb, or of other wounds treated in the same wards, and under similar local influences, indicate that the hygienic conditions generally are favourable.\* The occurrence of this disease after gun-shot injuries or amputation must be looked upon as most dangerous, in all probability necessitating excision of the injured bone, amputation, or disarticulation.

Some difficulty has been experienced by writers in deciding as to the cause of this formidable disease. Some attribute it to hospital influences, that is, unfavourable hygienic conditions; others to the result of irritation, such as may be produced by wounded being roughly carried after a comminuted gun-shot fracture.

It was remarked, during the Franco-Prussian War, 1870-71, that gun-shot fractures, owing either to the nature of the missiles or to the transport of the patients, were attended in a most remarkable manner by suppurative osteo-mylitis.†

Professor Longmore remarks: "It is not believed that any essential difference exists between the nature of the inflammation of the medullary tissue when developed by gun-shot wounds, and the inflammation which occasionally arises after the ordinary injuries and amputation of civil life; but it is its comparative frequency after gun-shot injuries, and after amputation consequent upon them, in men of previously sound constitutions in military practice, contrasted with the comparative rarity of its occurrence in patients of sound constitutions in civil practice, that has caused attention to be so much directed to it, and to its proper treatment by army surgeons."‡

The presence of the disease may be suspected when, after an operation or injury, the patient is attacked with shivering, deep-seated pain, and

\* Fayrer's 'Clinical Surgery,' p. 42.

† 'Army Medical Reports, 1871,' p. 253. Article by Surgeon-Major T. Fitzgerald.

‡ 'Medico-Chirurgical Transactions,' vol. xlviii., p. 44.

swelling. If it be an amputated bone, the medulla will protrude like a fungus, and the periosteum will be detached from the bone, the soft parts retract, and the bone appear dry and discoloured.

Fayrer says: "The symptoms in this formidable disease are, in the outset, said to be obscure. The local symptoms, no doubt, may be so when the affected bone is unexposed or undivided. The constitutional symptoms are those of pyæmia, and, at the outset, may be mistaken for a mere access of fever, a rigor such as may follow any surgical operation, or may occur from other causes. But as the local and constitutional symptoms progress, the doubt is soon cleared up. The symptoms, in the acute form, generally make their appearance early, within a week or ten days. It may be earlier, after the operation, wound, or injury. The stump, wound, or contusion may have been doing well. It may, perhaps, have sloughed a little, and the sloughs have cleared away, healthy granulations having appeared. The flaps may have united almost by the first intention, or all but at a point or two, whence discharge continues. The pain is not necessarily acute, and the tenderness on pressure of the stump is but slightly increased. The discharge becomes more profuse, but it is not healthy, well-elaborated pus. A probe being introduced, the bone is found dry and denuded, and, if exposed, the medulla will probably be found protruding like a fungus, whilst the periosteum is stripped from the end of the bone. With all this there may have been only a quickened pulse; or a febrile condition at some time of the day, the temperature at others being at, or even below, the natural standard; or rigors, as yet so slight as hardly to have attracted attention, may have occurred. Such are the early stage and symptoms, local and constitutional. These rapidly progress and develop themselves in the most marked manner. And now the critical period has arrived when it is necessary to make a thorough examination and decide the question whether it be osteo-myelitis or not. Exploration should be made with the finger, the stump, if necessary, being sufficiently reopened to admit of doing so, and the condition of the bone should be carefully examined and ascertained. In incipient cases the medulla will be found protruding like a fungus, and the bone surrounding it exposed to a greater or lesser extent. At a later period, the end of the medulla is found already blackened and encrusted, but within it is a putrid mass of bone débris and pus—a probe readily passing down the entire length of the shaft. In the former stage you can wait and watch progress, the mischief may be limited, and a ring of bone be thrown off. But in the latter case immediate interference is necessary, and nothing less than amputation, either at or above the next joint, will suffice. The constitutional symptoms will also have indicated the necessity for interference, and they are the symptoms of *pyæmia* of a marked character."\*

\* Fayrer's 'Clinical Surgery,' p. 45.

"The condition of the soft parts must not deceive. It is no uncommon thing to see the dead and putrid bone lying in the midst of perfectly healthy soft parts, and therefore the condition of the bone and the constitutional symptoms must be the guide as to the time and necessity for operation."

In cases where the symptoms may lead one to suspect that osteo-myelitis is taking place in a bone that has not had its medulla, or even its surface, exposed, the trephine, if it can be applied, should be had recourse to; and the discovery that the cavity of the bone is the seat of diffuse suppuration, as a general rule, lead to amputation or excision. Removal of the diseased bone being the only means of affording any prospect of recovery, the question is, whether amputation of only the portion diseased, or of the limb, is necessary.

Baron Larrey was of opinion that the disease might be limited, extend partially, or invade the whole of the bone; he, therefore, considered that resection was sometimes necessary, sometimes consecutive amputation, and sometimes disarticulation.

M. Jules Roux, in consequence of the fatal results of amputation and resection for this disease, proposed and carried out disarticulation of the injured bone. Of twenty-two cases in which he performed secondary disarticulation of joints for osteo-myelitis, all recovered; whereas every soldier died whose limb was secondarily amputated, through the continuity of the injured bone, after the battles of Magenta, Montebello, and Solferino.

Mr. Longmore considers that, "if amputation in continuity be performed while the endosteum is suffering from the inflammatory irritation excited by the violent injury to which the whole bone has been subjected, especially when this has assumed a chronic form, the endosteitis will most probably still pursue its course, even though the divided soft parts may at first become healed, slowly inducing death, more or less extensive, of bony tissue, and in time the usual consequences of such a condition throughout the whole stump.

"The morbid condition of the endosteum does not usually extend from the shafts of bones into their apophyses.

"When amputation has been followed by the disease, exarticulation should not in any case be resorted to for the removal of the diseased stump, until the effect of complete removal of every particle of the dead bone by proper surgical measures has been ascertained.

"Experience shows that, although a patient's constitution may be greatly impaired by the prolonged local diseased action to which it has been subjected, and though there may be every reason to conclude that the articular extremity of the bone is in the condition understood by the term "osteoporosis," yet the complete removal of the endosteitic sequestra

may speedily be followed by a restoration of the general health, and by a condition of the stump so sound and firm that it may be applied to any purpose of utility for which it may be competent, according to its length and position.”\*

Fayrer does not urge the operation of disarticulation always in preference to section of the bone at the next segment of the limb. He says, in the cases of the hip and shoulder, disarticulation, of course, alone is practicable; whereas in the leg and forearm, the respective advantages of disarticulation at the elbow or knee may fairly be questioned—and he has no hesitation in saying that, except in cases of endemic tendency to osteo-myelitis, section of the humerus or femur, in their lower third, is as good, if not a better operation than disarticulation. The great point to be attained is removal of the whole of the suppurating bone. Whenever there is an endemic tendency to osteo-myelitis in a hospital, this disarticulation, though, in itself, inferior as an operation to section of the bone (according to his view in the case of elbow and knee), should be preferred to amputation through the bone, as the fresh bone-wound might, under the endemic influence, give rise to an attack of osteo-myelitis.†

Operative measures should be adopted at an early period, before pyæmic symptoms have commenced to appear, as, once that disease has set in, amputation, disarticulation, or excision are of no avail. It is, however, a difficult point to decide how long amputation may be deferred on the chance of mischief being limited, and the diseased part thrown off without the constitution being affected.

The constitutional treatment in this disease should be improvement of the system by tonic wine, nutriment, change of air, and strict attention to hygienic conditions.

\* Longmore's 'Remarks on Osteo-Myelitis.'—'Medico-Chirurgical Transactions,' vol. xlviii., p. 61.

† Fayrer's 'Clinical Surgery,' p. 36.

## SCURVY.

WHEN scurvy presents itself among soldiers in time of war, it appears under different forms, such as swelling of the limbs, ulceration, especially of old cicatrices, having a livid colour and irregular tumid border, with a surface covered with a spongy, dark-coloured, strongly-adherent foetid crust, dysentery, hæmorrhage, nodes, spongy swelling in the gums and petechiæ; rendering the subjects quite inefficient, and *aggravating wounds or injuries* by preventing their healing.

“Measures to be adopted in time of war, or in prolonged sojourn on board ship, or at stations where fresh vegetables are scarce, are—

“1. The supply of fresh vegetables and fruits by all the means in our power. Even unripe fruits are better than none, and we must risk a little diarrhœa for the sake of their antiscorbutic properties. In time of war every vegetable should be used, which it is safe to use, and when made into soups, almost all are tolerably pleasant to eat.

“2. The supply of the dried vegetables, especially potato, cabbage, and cauliflowers; turnips, parsnips, &c., are perhaps less useful; dried peas and beans are useless. As a matter of precaution, these dried vegetables should be issued early in a campaign, but should never supersede the fresh vegetables.

“3. Good lemon-juice should be issued daily (1 oz.), and it should be seen that the men take it.

“4. Vinegar ( $\frac{1}{2}$  oz. to 1 oz. daily) should be issued with the rations, and used in the cooking.

“5. Citrates, tartrates, lactates, and malates of potash, should be issued in bulk, and used as drinks, or added to the food. Potash should be selected as the base, as there is seldom any chance of the supply of soda being lessened. The easiest mode of issuing these salts would be to have packets containing enough for one mess of twelve men, and to instruct the men how important it is to place them in the soups or stews. Possibly they might be mixed with the salt, and issued merely as salt.”\*

Iron, in the form of the tincture of the chloride, in doses of thirty drops three times a day, has been recommended by Dr. Hammond for this disease. Attention should be paid to cleanliness, air, and exercise.

\* Parkes's 'Manual of Practical Hygiene,' p. 492.

## FOOTSORENESS.

PROFESSOR PARKES remarks : " Footsoreness is generally a great trouble, and frequently arises from faulty boots, undue pressure, chafing, riding of the toes from narrow soles, &c. Rubbing the feet with tallow, or oil, or fat of any kind, before marching, is a common remedy. A good plan is to dip the feet in very hot water, before starting, for a minute or two ; wipe them quite dry, then rub them with soap (soft soap is the best) till there is a lather ; then put on the stocking. At the end of the day, if the feet are sore, they should be wiped with a wet cloth, and rubbed with tallow and spirits mixed in the palm of the hand (Galton). Pedestrians frequently use hot salt and water at night, and add a little alum. Sometimes the soreness is owing simply to bad stockings ; this is easily remedied. Stockings should be frequently washed, then greased. Some of the German troops use no stockings, but rags folded smooth over the feet. This is a very good plan.

"Very often soreness is owing to neglected corns, bunions, or in-growing nails ; and the surgeon must not despise the little surgery necessary to remedy these things ; nothing, in fact, can be called little if it conduces to efficiency.

"If blisters form on the feet, the men should be directed not to open them during the march, but at the end of the time to draw a needle and thread ; the fluid gradually oozes out.

"All footsore men should be ordered to report themselves at once.

*Chafing.*—"Occasionally men are much annoyed with chafing between the nates, or inside of the thighs. Sometimes this is simply owing to the clothes, but sometimes to the actual chafing of the parts. Powders are said to be the best—flour, oxide of zinc, and, above all, it is said, fullers' earth."\*

\* Parkes's 'Manual of Practical Hygiene,' pp. 399, 400.

## COOKING-PLACES.

"THE simplest kitchen consists of a trench dug in the direction that the wind is blowing, of such width that the kettle, when placed on it, should not rest above an inch on each side. When the width is nine inches, its depth should be twelve at the end from which the wind is blowing, and continue that depth for four feet, decreasing then gradually to three inches at the opposite end, where a space must be left equal to the breadth of the trench, to serve for a chimney. The fire is lit at the end where the trench is deep; it should not extend beyond three or four feet up the trench. The kettles are placed touching one another along this trench; dry sods should be used to stop up the chinks made by the roundness of the kettles, so that the space under them may form a flue. It is advisable to pile up sods, or, with stones and earth, to erect a chimney of at least one foot in height at the end away from the fire. All grass round the fire-places should be cut, to prevent accidents from fire.

"These kitchens are susceptible of great improvement. The chimney can be made of mud, or wattle and daub, and the draught may be increased by using short pieces of hoop-iron, as bars stretched across the trench to support a filling-in of clay round each kettle, or, in other words, to make a regular place for the kettle, into which it will fit exactly, so that its position may be frequently changed, to prevent the contents of one being cooked before the other. As the day following the wind may change to an exactly opposite direction, a similar trench must be dug in continuation of the former one, the same chimney being used. In this manner the same chimney will serve for trenches cut to suit the wind blowing from all four quarters. The openings from these trenches into the chimney must all be closed with a sod, except the one to be used when the fire is lit. In some places, where bricks or stones suitable to the purpose are to be had, it is better to construct these kitchens on the ground instead of below its surface.

"In well-wooded countries, like America, two logs rolled together in the direction of the wind, the fire being kindled between them, make a good kitchen. In such places fuel is no object, so the construction of chimneys can be dispensed with, and the kettles hung from a stick resting at each end on a forked upright.

*Field Ovens.*—"The simplest method of making them is as follows: Take



any barrel (the more iron hoops on it the better), the head being out ; lay it on its side, having scraped away the ground a little in the centre to make a bed for it ; or, if there is a bank near, excavate a place for it, taking care that the end of the barrel does not reach within six inches of the edge of the bank ; cover it over with a coating of about six or eight inches of wet earth or thick mud, except at the open end, which is to be the mouth of the oven. Pile up some sand or earth to a thickness of about six inches over the mud, arranging for an opening three inches in diameter being left as a flue (to increase the draught) to lead from the upper side of the barrel, at the far end, through the mud and earth. This flue is only left open when the fire for heating is burning. When bread is put in, it should be covered over. Form an even surface of well-kneaded mud at the bottom within the barrel, to form a flooring to place the bread on. Light a fire within the barrel, and keep it up until the staves are burnt. You will then have a good oven of tough, burnt clay, tied together by the iron barrel-hoops. When required for use, heat it as if it was an ordinary oven. When the ashes are drawn out, and the bread put in, close the mouth with some boards, or a piece of tin or iron.”\*

\* ‘The Soldier’s Pocket-Book,’ by Col. Sir Garnet Wolseley, p. 152.

## LATRINES.

A LATRINE should be made as soon as the hospital arrives on the ground. A small shallow trench will suffice for one night.

In standing camps, latrines may be made with seats, as shown in fig. 115. The seat being a simple pole, additional comfort may be given by adding a top pole to form a back; but this is quite needless, except for hospitals. The trench should be made as narrow as possible, and from three to four feet deep. Too much care cannot be bestowed in selecting the site of the

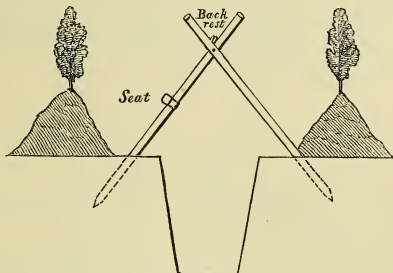


Fig. 115.\*

latrine, and placing it so that no filtration from it may reach the water supply. A small piece of canvas may be carried to give some shelter to the latrine. If trees or brush are in the neighbourhood, it can be inclosed by a screen about four feet high. Twice a day, about ten A.M. and six P.M., the bottom of the pit should be covered with a three-inch layer of dry earth. The wood ashes from the cooking-places should be spread about in the vicinity. Lime, if it is to be had, should be used in large quantities.

The health and comfort of every one in hospital depends very much upon the manner in which these duties are conducted.

\* Fig. 115 is taken from Regulations and Instructions for Encampments, Horse Guards, 1st August, 1871, plate xxvi.

## WATER.

PURE water being so essential, the following instructions may be given here: "When halting ground is reached, it may be necessary to filter the water. A common plan is to carry a cask, charred inside, and pierced with small holes at the bottom; it is sunk in a small stream, and the water rises through the holes. A better plan still, is to have two casks, one inside the other; the outer pierced with holes at the bottom, and the inner near the top; the space between is filled with sand, gravel, or charcoal if procurable; the water rises through the gravel between the barrels, and flows into the inner barrel (fig. 116).

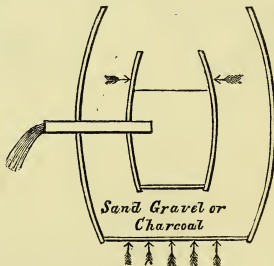


Fig. 116.

"In the French army it is ordered that, if other means cannot be procured, fresh and inodorous straw be taken, and chopped fine, and pressed at the bottom of a tube pierced with holes; if possible, charcoal is to be intercalated among the straw. Great care must be taken to have the straw pure, and to change it often.

"Medical officers should make arrangements for the different places of supply. Men and cattle should be watered at different points; places should be assigned for washing; and if removal of excreta by water be attempted, the excreta should flow in far below any possible spring. In

case of a spring, several reservoirs of wood should be made, and the water allowed to flow from one to another—the highest for men, the second for cattle. If it is a running stream, localities should be fixed for the special purpose; that for the men's drinking-water should be highest up the stream, for animals below, washing lowest; sentries should be placed as soon as possible.

“The distribution of water should be regulated; streams are soon dried up, made turbid, and the water becomes undrinkable for want, perhaps, of simple management.”\*

“Water may be filtered through a sponge, or a cloth of any kind; or by rolling a handful of grass in the form of a cone, and having dipped it into the pool, allowing it to drip from one end.”†

In India, especially on board river steamers, where drinking-water is taken direct from the river, which is generally very muddy, a lump of alum is moved rapidly through it with satisfactory results.

## DIETS.

The following scale of diets has been proposed for fixed hospitals; for further particulars respecting it, reference should be made to the Hospital Regulations.

On service in the field the sick and wounded would be supplied with their usual daily rations, which might be supplemented by medical comforts, or such articles as the Supply Department might be able to provide.

\* Parkes's ‘Manual of Practical Hygiene,’ p. 62.

† Hamilton's ‘Military Surgery,’ p. 153.

## DIET

## Military Hospitals.—Articles composing the

Tea.	Milk.	Low.	Chicken.
Bread . . 12 oz.	Bread . . 12 oz.	Meat . . 8 oz.*	Fowl . . 8 oz.*
Tea . . . $\frac{1}{2}$ ,,	Rice . . . 2 ,,	Bread . . 14 ,,	Bread . . 16 ,,
Sugar . . . 2 $\frac{1}{2}$ ,,	Milk . . . 3 pints	Salt . . . $\frac{1}{2}$ ,,	Potatoes . . 8 ,,
Milk . . . 6 ,,	Sugar . . 1 oz.	Tea . . . $\frac{1}{4}$ ,,	Salt . . . $\frac{1}{4}$ ,,
		Sugar . . 1 $\frac{1}{2}$ ,,	Tea . . . $\frac{1}{4}$ ,,
		Milk . . . 6 ,,	Sugar . . 1 $\frac{1}{2}$ ,,
		Butter . . 1 ,,	Milk . . . 6 ,,
			Butter . . 1 ,,
		* Without bone.	* 10 (if with bone).

## BREAKFAST.

Tea . . . 1 pint	Milk . . . 1 pint	Tea . . . 1 pint	Tea . . . 1 pint
Bread . . . 4 oz.	Bread . . . 6 oz.	Bread . . . 5 oz.	Bread . . . 6 oz.
		Butter . . . $\frac{1}{2}$ ,,	Butter . . . $\frac{1}{2}$ ,,

## DINNER.

Tea . . . 1 pint	Rice milk . . 1 pint	Beef tea . . 15 oz.	Fowl . . . 8 oz.
Bread . . . 4 oz.	Bread . . . 4 oz.	Bread . . . 4 ,,	Either roasted or made into chicken tea . . . 12 oz.
	Sugar . . . 1 ,,		Bread . . . 6 ,,

## SUPPER.

Tea . . . 1 pint	Milk . . . 1 pint	Tea . . . 1 pint	Tea . . . 1 pint
Bread . . . 4 oz.	Bread . . . 4 oz.	Bread . . . 5 oz.	Bread . . . 6 oz.
		Butter . . . $\frac{1}{2}$ ,,	Butter . . . $\frac{1}{2}$ ,,

*Note.*—Drinks for patients are to be made and charged according to the following proportions:—

*Barley Water.*—Barley, 2 oz.; sugar, 2 oz.; for every five pints.

*Rice Water.*—Rice, 2 oz.; sugar, 2 oz.; for every five pints.

## TABLE.

## Different Diets for a day.—Avoirdupois Weight.

Half.	Roast.	Entire.	Varied.
Meat . . 8 oz.*	Roast, Chop, or Steak.	Meat . . 12 oz.*	Meat . . 12 oz.*
Bread . . 16 ,,	—	Bread . . 16 ,,	Bread . . 18 ,,
Potatoes . 8 ,,	Meat . . 8 oz.*	Potatoes . 16 ,,	Potatoes . 16 ,,
Barley . . 1½ ,,	Bread . . 18 ,,	Barley . . 1½ ,,	Salt . . ¼ ,,
Salt . . ¾ ,,	Potatoes . 8 ,,	Salt . . ¾ ,,	Tea . . ¼ ,,
Tea . . ¼ ,,	Salt . . ¼ ,,	Tea . . ¼ ,,	Sugar . . 1½ ,,
Sugar . . 1½ ,,	Tea . . ¼ ,,	Sugar . . 1½ ,,	Milk . . 6 ,,
Milk . . 6 ,,	Sugar . . 1½ ,,	Milk . . 6 ,,	Vegetables 4 ,,
Vegetables 4 ,,	Tea . . ¼ ,,	Vegetables 4 ,,	Butter . . 1 ,,
Butter . . 1 ,,	Sugar . . 1½ ,,	Butter . . 1 ,,	—
Flour . . ¼ ,,	Milk . . 6 ,,	Flour . . ¼ ,,	Meat—roasted, baked, or stewed.
	Vegetables 4 ,,		
	Butter . . 1 ,,		
* 10 (if with bone).	* 10 (if with bone).	* 15 (if with bone).	* 15 (if with bone).

## BREAKFAST.

Tea . . 1 pint	Tea . . 1 pint	Tea . . 1 pint	Tea . . 1 pint
Bread . . 6 oz.	Bread . . 6 oz.	Bread . . 6 oz.	Bread . . 6 oz.
Butter . . ½ ,,	Butter . . ½ ,,	Butter . . ½ ,,	Butter . . ½ ,,

## DINNER.

Soup . . 15 oz.	Roast, Chop, or Steak.	Soup . . 1 pint	Meat . . 12 oz.
Meat . . 8 ,,	—	Meat . . 12 oz.	Bread . . 6 ,,
Bread . . 4 ,,	Meat . . 8 oz.	Bread . . 4 ,,	Potatoes . 16 ,,
Potatoes . 8 ,,	Bread . . 6 ,,	Potatoes . 16 ,,	Vegetables . 4 ,,
	Potatoes . 8 ,,		
	Vegetables 4 ,,		

## SUPPER.

Tea . . 1 pint	Tea . . 1 pint	Tea . . 1 pint	Tea . . 1 pint
Bread . . 6 oz.	Bread . . 6 oz.	Bread . . 6 oz.	Bread . . 6 oz.
Butter . . ½ ,,	Butter . . ½ ,,	Butter . . ½ ,,	Butter . . ½ ,,

*Lemonade*.—Two large lemons; and sugar, 1½ oz., to two pints.

*Gruel*.—Oatmeal, 2 oz.; and sugar, 1½ oz., to two pints.

DESCRIPTIVE NUMERICAL RETURN\* OF WOUNDS AND INJURIES received in  
 Action admitted into the Hospital of the \_\_\_\_\_, between  
 the \_\_\_\_\_ of \_\_\_\_\_, and \_\_\_\_\_ of \_\_\_\_\_ 18\_\_\_\_\_.  
 \_\_\_\_\_ the \_\_\_\_\_ of \_\_\_\_\_ 18\_\_\_\_\_.

Classification and Specification of Wounds and Injuries.		Remained on the 18	Since admitted.	Died.	Discharged to duty.	Transferred.			Remaining on the 18
						To other hos- pitals.	Re-admitted for other diseases.	Re-admitted for capital op.	
1. Gunshot wounds of the Head.	1. Contusion and simple flesh wounds of scalp	{ Slight Severe							
	2. With contusion or fracture of the cranium, without depression . . .								
	3. Ditto, with depression . . .								
	4. Penetrating the cranium. . .								
	5. Perforating ditto . . .								
2. Gunshot wounds of the Face.	1. Simple flesh contusions and wounds . . .	{ Slight Severe							
	2. Penetrating, perforating, or lacerating the bony structure without lesion of important organs								
	3. Ditto, with lesion of the . . .								
	4. With fracture of the lower jaw .								
3. Gunshot wounds of the Neck.	1. Simple flesh contusions and wounds . . .	{ Slight Severe							
	2. With injury of the . . .								
	Carried forward . . . . .								

\* Classification arranged by Inspector-General Taylor, C.B.



DESCRIPTIVE NUMERICAL RETURN OF WOUNDS AND INJURIES—continued.

Classification and Specification of Wounds and Injuries.		Remained on the 18	Since admitted.	Died.	Discharged to duty.	Transferred.			Remaining on the 18
						To other hospitals or stations.	Re-admitted for other diseases.	Re-admitted for capital op.	
4. Gunshot wounds of the Chest.	Brought forward . . . . .								
	1. Simple flesh contusions and wounds . . . . .	{	Slight Severe						
	2. With injury of bony or cartilaginous parietes without lesion of contents . . . . .								
	3. With lesion of contents by contusion or with non-penetrating wound. . . . .								
	4. Penetrating, and ball lodged, or apparently lodged . . . . .								
5. Gunshot wounds of the Abdomen.	5. Perforating con- tents . . . . .	{	Superficially Deeply . . .						
	1. Simple flesh contusions and wounds . . . . .								
	2. Contusion or non-penetrating wound with lesion of {								
	3. Penetrating or perforating, with lesion of {								
	6. Gunshot wounds of the Back and Spine. {								
6. Gunshot wounds of the Back and Spine.	1. Simple flesh contusions and wounds . . . . .	{	Slight Severe						
	2. With fracture of vertebra, without lesion of spinal cord . . .								
	3. With lesion of spinal cord . . .								
Carried forward . . . . .									

DESCRIPTIVE NUMERICAL RETURN OF WOUNDS AND INJURIES—*continued.*

Classification and Specification of Wounds and Injuries.		Remained on the 18	Since admitted.	Died.	Discharged to duty.	Transferred.			Remaining on the 18
						To other hospi- tals or stations.	Re-admitted for other diseases.	Re-admitted for capital op.	
Brought forward . . . . .									
7. Gun-shot contusions and wounds of the perineum and genital and urinary organs, not being at the same time wounds of the peritoneum . . . . .	{								
8. Gunshot wounds of the Upper extremities.	{	1. Simple flesh contusions and wounds . . . . .	{ Slight Severe						
		2. With contusion and partial fracture of long bones, including fracture of the clavicle and scapula . . . . .							
		3. Simple fracture of long bones by contusion from round shot . . . . .							
		4. With compound fracture of . . . . .	Humerus . . . . .						
			Radius . . . . .						
			Ulna . . . . .						
			Ulna and radius . . . . .						
		5. Penetrating, perforating, or lacerating the several structures of the carpus and metacarpus . . . . .							
		6. Dividing or lacerating the structures of the fingers or thumbs. . . . .							
9. Gunshot wounds of the Lower extremities.	{	1. Simple flesh contusions and wounds . . . . .	{ Slight Severe						
		2. With contusion and partial fracture of long bones . . . . .							
		3. With simple fracture of long bones by contusion of round shot . . . . .							
		Carried forward . . . . .							

DESCRIPTIVE NUMERICAL RETURN OF WOUNDS AND INJURIES—*continued.*

Classification and Specification of Wounds and Injuries.		Remained on the 18	Since admitted.	Died.	Discharged to duty.	Transferred.			Remaining on the 18
						To other hospitals or stations.	Re-admitted for other diseases.	Re-admitted for capital op.	
9. Gunshot wounds of the Lower extremities— <i>contd.</i>	Brought forward . . . . .								
	4. With compound fracture of . . . . .								
	Femur . . . . .								
	Tibia only . . . . .								
	Fibula only . . . . .								
	5. Penetrating, perforating, or lacerating the several structures of the tarsus and metatarsus . . . . .								
	6. Dividing or lacerating the structures of the toes . . . . .								
10. Gun-shot wounds with direct injury of the large Arteries, not being at the same time cases of compound fracture . . . . .									
11. Gun-shot wounds with direct penetration or perforation of the larger Joints . . . . .	With fracture of bone . . . . .								
	Without fracture . . . . .								
12. Gun-shot wounds with direct injury of the large Nerves, not being at the same time cases of compound fracture . . . . .									
13. Sword and lance wounds of . . . . .									
14. Bayonet wounds of . . . . .									
Carried forward . . . . .									

DESCRIPTIVE NUMERICAL RETURN OF WOUNDS AND INJURIES—continued.

Classification and Specification of Wounds and Injuries.	Remained on the 18	Since admitted.	Died.	Discharged to duty.	Transferred.			Remaining on the 18
					To other hospi- tals or stations.	Re-admitted for other diseases.	Re-admitted for capital op.	
Brought forward . . . . .								
15. Miscellaneous wounds and injuries received in action . . . . .								
Total wounds and injuries received in action . . . . .								

The Tables on pages 264 and 265 represent the Forms of returns for Injuries inflicted in particular battles, and for the results of their hospital treatment.

										Remained on the 18	Since admitted.	Died.	Discharged cured.	Transferred.			Remaining on the 18
Amputations.																	
Excisions.																	
Upper Extremities.																	
Lower Extremities.																	
Shoulder-joint . . . . .																	
Arm . . . . .																	
Forearm . . . . .																	
Thumbs . . . . .																	
Fingers . . . . .																	
Hip-joint . . . . .																	
Thigh { At upper third . . . . .																	
{ At middle third . . . . .																	
{ At lower third . . . . .																	
Leg . . . . .																	
Ankle-joint . . . . .																	
Medio-tarsus . . . . .																	
Tarso-metatarsus . . . . .																	
Toes . . . . .																	
Trephining . . . . .																	
Ligature of Arteries {																	
Total . . . . .																	

## CLASSIFIED RETURN OF WOUNDS AND INJURIES RECEIVED IN ACTION ON THE

N.B. Separate forms should be used for (1) officers and for (2) non-commissioned officers and men.

[This form may be used for various purposes where Returns of Wounds and Injuries are to be made, the headings being altered according to circumstances.]

REGIONS OF THE BODY WOUNDED OR INJURED.	Admissions with Wounds or Injuries.							Deaths consequent of the foregoing Wounds and Injuries.						
	Total Wounded or Injured.	Projectile or weapon by which the Wounds or Injuries were inflicted.						Among Total Wounded or Injured.	Projectile or weapon by which the Wounds or Injuries were inflicted.					
		Cannon Ball.	Shell.	Grape Shot.	Rifle, Musket, Pistol Ball.	Sword, Lance.	Bayonet.		Cannon Ball.	Shell.	Grape Shot.	Rifle, Musket, Pistol Ball.	Sword, Lance.	Bayonet.
All Wounds and Injuries.	1. Wounds of the Head . . . . .													
	2. Wounds of the Face . . . . .													
	3. Wounds of the Neck . . . . .													
	4. Wounds of the Chest . . . . .													
	5. Wounds of the Abdomen . . . . .													
	6. Wounds of the Back and Spine . . . . .													
	7. Wounds of Perineum and Genital and Urinary Organs, not being wounds of the Peritoneum . . . . .													
	8. Wounds of the upper extremities . . . . .													
	9. Wounds of the lower extremities . . . . .													
	10. Wounds with direct injury of the Large Arteries, not being Cases of Compound Fracture . . . . .													
	11. Wounds with direct penetration or perforation of the Large Joints . . . . .													
	12. Wounds with direct injury of the Large Nerves, not being at the same time Cases of Compound Fracture . . . . .													

N.B. The classification will be continued by the expansion of each of these twelve heads, so as to show the precise character of the wounds and injuries.

CLASSIFIED RETURN OF WOUNDS AND INJURIES OF EVERY KIND received in action abroad, and admitted into the Hospital of \_\_\_\_\_ of \_\_\_\_\_ between the \_\_\_\_\_ of \_\_\_\_\_ and \_\_\_\_\_

N.B. Separate forms should be used for (1) officers, and for (2) non-commissioned officers and men.  
[A separate form may be used for Gun-shot Wounds as distinguished from other wounds.]

REGIONS OF THE BODY WOUNDED OR INJURED.	Remained on the 18	Since admitted.			Amputation.			Other operations.	Died.	Discharged to duty.	Trans-ferred.		Remaining on the 18
					Primary	Secondary.	Excision.				To other Hospitals.	To England.	
All Wounds and Injuries.													
1. Wounds of the Head . . . . .													
2. Wounds of the Face . . . . .													
3. Wounds of the Neck . . . . .													
4. Wounds of the Chest . . . . .													
5. Wounds of the Abdomen . . . . .													
6. Wounds of the Back and Spine . . . . .													
7. Wounds of the Perineum and Genital and Urinary Organs, not being wounds of the Peritoneum .													
8. Wounds of the Upper Extremities . . . . .													
9. Wounds of the Lower Extremities . . . . .													
10. Wounds with direct injuries of the Large Arteries, not being Cases of Compound Fracture . . . . .													
11. Wounds with direct Penetration or Perforation of the Large Joints . . . . .													
12. Wounds with direct injury of Large Nerves, not being at the same time Cases of Compound Fracture . . . . .													

N.B. The classification will be continued by the expansion of each of these heads so as to show the precise character of the wounds and injuries.





# FORMULARY OF PRESCRIPTIONS.

## ANTISEPTICS.

### 1. Solution of Chlorinated Soda.

Used locally in all affections attended with foetor, and may be applied diluted as a gargle, wash, poultice, or by lint. Also as a disinfecting agent.

### 2. Solution of Permanganate of Potash.\*

(a.) *Dressings for Ulcers, Sores, &c.*—Keep applied a piece of soft lint or rag, which moisten frequently with the fluid, more or less diluted with water according to circumstances. Very foul and sluggish sores require the fluid from the full strength to that of 2 oz. to a pint of water; in other cases  $\frac{1}{2}$  fl. oz. to the pint.

(b.) *Poultices.*—Add 2 tea-spoonfuls of the fluid to the water used in making, and before applying pour a few drops on the surface of the poultice.

(c.) *Injections.*—Two tea-spoonfuls to a pint of water, gradually increasing the strength.

(d.) *Fomentations.*—One table-spoonful to a pint of warm water.

\* Condy's Disinfectant is double the strength of the Solution of Permanganate of Potash in the British Pharmacopœia.

### 3. Sir William Burnett's Solution of Chloride of Zinc.

	Proportions of Mixture.
To purify sick rooms, wards of hospitals . . . . .	1 to 100 of water.
To deprive night chairs, &c., of offensive odour . . . . .	
To deodorize cesspools and open privies, &c., &c. . . . .	

## BATHS.

### 1. Simple Bath.

	Temperature.
Hot bath . . . . .	98° to 105° Fahr.
Warm „ . . . . .	92 „ 98 „
Tepid „ . . . . .	85 „ 92 „
Cold „ . . . . .	56 „ 64 „

### 2. Compound Sulphur Bath.

Take of—

Precipitated sulphur . . . . .	2 oz.
Hyposulphite of soda . . . . .	1 oz.
Diluted sulphuric acid . . . . .	$\frac{1}{2}$ fl. oz.
Water . . . . .	30 C.
	Mix.

### 3. Acid Bath.

Take of—

Nitric acid . . . . .	1 $\frac{1}{2}$ fl. oz.
Hydrochloric acid . . . . .	1 fl. oz.
Water . . . . .	30 C.
	Mix.

## 4. Alkaline Bath.

Take of—

Carbonate of soda	.	.	.	4 oz.
Water	.	.	.	30 C.
Mix.				

## 5. Iodine Bath.

Take of—

Iodine	.	.	.	$\frac{1}{4}$ oz.
Solution of potash	.	.	.	2 fl. oz.
Water	.	.	.	30 C.
Mix.				

## 6. Mustard Foot Bath.

Take of—

Mustard, in powder	.	.	.	2 oz.
Hot water	.	.	.	4 C.
Mix.				

## CATAPLASMS. POULTICES.

## 1. Charcoal Poultice.

Take of—

Wood charcoal, in powder	.	.	.	$\frac{1}{4}$ oz.
Bread	.	.	.	2 oz.
Linseed meal	.	.	.	$1\frac{1}{2}$ oz.
Boiling water	.	.	.	10 fl. oz.

Macerate the bread in the water for a short time, near the fire, then mix, and add the linseed meal, gradually stirring the ingredients, that a soft poultice may be formed; mix with this half the charcoal and sprinkle the remainder on the surface of the poultice.

## 2. Chlorine Poultice.

Take of—

Solution of chlorinated soda	.	.	.	2 fl. oz.
Linseed meal	.	.	.	4 oz.
Boiling water	.	.	.	8 fl. oz.

Add the linseed meal gradually to the water, stirring constantly; then mix in the solution of chlorinated soda.

## 3. Linseed Meal Poultice.

Take of—

Linseed meal	.	.	.	4 oz.
Olive oil	.	.	.	$\frac{1}{4}$ fl. oz.
Boiling water	.	.	.	10 fl. oz.

Mix the linseed meal with the oil, then add the water gradually, constantly stirring.

## 4. Mustard Poultice.

Take of—

Mustard, in powder	.	.	.	2 $\frac{1}{2}$ oz.
Linseed meal	.	.	.	2 $\frac{1}{2}$ oz.
Boiling water	.	.	.	10 fl. oz.

Mix gradually the linseed meal with the water, and add the mustard, constantly stirring.

## CAUSTICS.

## 1. Compound Savin.

Take of—

Fresh savin, in powder	.	.	.	60 grs.
Burnt alum	.	.	.	15 grs.
Levigated red precipitate	.	.	.	15 grs.
Mix.				

## 2. Of Chloride of Zinc.

Take of—

Chloride of zinc.	.	.	.	1 part.
Fine flour	.	.	.	2 to 5 parts.
Mix.				

## COLLYRIA.

## 1. Collyrium of Alum.

Take of—

Alum	.	.	.	3 $\frac{1}{2}$ grs.
Distilled water	.	.	.	1 fl. oz.
Mix.				

## 2. Of Nitrate of Silver.

Take of—

Nitrate of Silver	.	.	.	1 gr.
Distilled water	.	.	.	1 fl. oz.
Mix.				

### 3. Of Sulphate of Copper.

Take of—

Sulphate of copper . . .	6 grs.
Distilled water . . .	1 fl. oz.
Mix.	

### 4. Of Opium.

Take of—

Tincture of opium . . .	30 min.
Distilled water . . .	1 fl. oz.
Mix.	

## ELECTUARIES.

### 1. Of Senna.

Take of—

Confection of senna . . .	2 oz.
Jalap, in powder . . .	60 grs.
Acid tartrate of potash . . .	120 grs.
Mix.	

### 2. Of Sulphur.

Take of

Precipitated sulphur . . .	120 grs.
Acid tartrate of potash . . .	30 grs.
Treacle . . .	6 fl. drs.
Mix.	

## DECOCTIONS.

1. Compound of aloes . . .	} British Pharma- copœia.
2. Of yellow bark . . .	
3. Of logwood . . .	
4. Of poppies . . .	
5. Of oak bark . . .	
6. Of taraxacum . . .	
7. Compound of sarsaparilla . . .	

## DRAUGHTS (Antispasmodic).

### 1. Of Ether and Opium.

Take of—

Spirit of ether . . .	30 min.
Tincture of opium . . .	20 min.
Peppermint water . . .	1½ fl. oz.
Mix.	

### 2. Of Chloroform.

Take of—

Chloroform . . .	5 min.
Camphor . . .	5 grs.
Mucilage . . .	1 fl. dr.
Water . . .	10 fl. dr.
Mix.	

## DRAUGHTS (Astringent).

### 1. Of Iron and Calumba.

Take of—

Tincture of perchloride of iron . . .	15 min.
Infusion of calumba . . .	1 fl. oz.
Mix.	

### 2. Of Turpentine.

Take of—

Oil of turpentine . . .	10 min.
Mucilage of gum arabic . . .	1 fl. oz.
Mix.	

### 3. Of Quinia and Sulphuric Acid.

Take of—

Sulphate of quinia . . .	2 grs.
Dilute sulphuric acid . . .	30 min.
Compound tincture of car- damoms . . .	1 fl. dr.
Distilled water . . .	1½ fl. oz.
Mix.	

## DRAUGHTS (Cathartic).

### 1. Black Draught.

Take of—

Sulphate of magnesia . . .	½ oz.
Tincture of jalap . . .	1 fl. dr.
Infusion of senna . . .	1½ fl. oz.
Mix.	

### 2. Rhubarb and Magnesia.

Take of—

Rhubarb, in powder . . .	20 grs.
Carbonate of magnesia . . .	15 grs.
Sulphate of magnesia . . .	120 grs.
Peppermint water . . .	1½ fl. oz.
Mix.	

**3. Warm Aperient.**

Take of—

Extract of rhubarb	. . .	10 grs.
Phosphate of soda	. . .	60 grs.
Compound decoction of aloes	. . .	1 fl. oz.
Mix.		

**DRAUGHTS (Antacid).****1. Bicarbonate of Potash.**

Take of—

Bicarbonate of potash	. . .	30 grs.
Water	. . .	1 fl. oz.
Mix.		

**2. Carbonate of Ammonia.**

Take of—

Carbonate of ammonia	. . .	5 grs.
Tincture of orange peel	. . .	1 fl. dr.
Infusion of chiretta	. . .	7 fl. drs.
Mix.		

**3. Bicarbonate of Soda and Creasote.**

Take of—

Bicarbonate of soda	. . .	10 grs.
Creasote	. . .	1 min.
Infusion of calumba	. . .	1½ fl. oz.
Mix.		

**DRAUGHTS (Anthelmintic).****1. Of Fern Root.**

Take of—

Liquid extract of fern root	. . .	40 min.
Tincture of ginger	. . .	15 min.
Refined sugar	. . .	20 grs.
Mucilage of gum arabic	. . .	1 fl. dr.
Water	. . .	1½ fl. oz.
Mix.		

**2. Of Kamela.**

Take of—

Kamela, in powder	. . .	90 grs.
Aromatic powder	. . .	10 grs.
Mucilage of gum arabic	. . .	½ oz.
Water	. . .	1½ fl. oz.
Mix.		

**3. Of Kousso.**

Take of—

Kousso	. . .	¼ oz.
Boiling distilled water	. . .	4 fl. oz.
Mix.		

**4. Of Turpentine and Castor Oil.**

Take of—

Oil of turpentine	. . .	1 fl. oz.
Castor oil	. . .	1 fl. oz.
Mix.		

**DRAUGHTS (Diaphoretic).****1. Of Acetate of Ammonia.**

Take of—

Solution of acetate of ammonia	. . .	40 min.
Water	. . .	½ fl. oz.
Mix.		

**2. Of Citrate of Ammonia.**

Take of—

Carbonate of ammonia	. . .	16 grs.
Citric acid	. . .	20 grs.
Water	. . .	1½ fl. oz.
Mix.		

**DROPS (Eye).****1. Of Hydrocyanic Acid.**

Take of—

Dilute hydrocyanic acid	. . .	1 fl. dr.
Distilled water	. . .	1 fl. oz.
Mix.		

**2. Of Atropia.**

Take of—

Atropia, in crystals	. . .	4 grs.
Rectified spirit	. . .	1 fl. dr.
Distilled water	. . .	1 fl. oz.
Mix.		

**3. Of Sulphate of Zinc.**

Take of—

Sulphate of zinc	. . .	2 grs.
Distilled water	. . .	1 fl. oz.
Mix.		

ENEMATA (Nutritive).

1. Of Cod-liver Oil.

Take of—

Cod-liver oil . . . .	1 fl. oz.
Essence of beef . . . .	4 fl. oz.
Brandy . . . . .	$\frac{1}{2}$ fl. oz.
Milk . . . . .	$\frac{1}{2}$ oz.
Tincture of opium . . . .	20 min.

Mix.

2. Of Quinine and Beef Tea.

Take of—

Sulphate of quinine . . . .	6 grs.
Brandy . . . . .	$\frac{1}{2}$ fl. oz.
Milk . . . . .	1 fl. oz.
Strong beef tea . . . . .	6 to 8 fl. oz.

Mix.

ENEMATA (Purgative).

1. Of Sulphate of Magnesia.

Take of—

Sulphate of magnesia . . . .	1 oz.
Olive oil . . . . .	1 fl. oz.
Mucilage of starch . . . .	15 fl. oz.

Mix.

2. Of Castor Oil.

Take of—

Castor oil . . . . .	2 fl. oz.
Mucilage of starch . . . .	8 fl. oz.

Mix.

3. Of Soap.

Take of—

Soft soap . . . . .	1 oz.
Boiling water . . . . .	1 O.

Mix.

4. Of Turpentine.

Take of—

Oil of turpentine . . . . .	1 fl. oz.
Mucilage of starch . . . .	15 fl. oz.

Mix.

ENEMATA (Sedative).

1. Of Opium.

Take of—

Tincture of opium . . . .	30 min.
Mucilage of starch . . . .	2 fl. oz.

Mix.

ENEMATA (Antispasmodic).

1. Of Assafoetida.

Take of—

Tincture of assafoetida . . . .	6 fl. drms.
Mucilage of starch . . . .	6 fl. oz.

FOMENTATIONS.

1. Spongio-piline, wrung out of hot water, and applied.

2. Of Turpentine.

Flannel or spongio-piline wrung out of hot water, and sprinkled with turpentine.

3. Of Poppies.

Take of—

Capsules, sliced or bruised . . . .	3 to 5
Water . . . . .	2 O.

Boil for a quarter of an hour.

GARGLES.

1. Of Hydrochloric Acid.

Take of—

Dilute hydrochloric acid . . . .	1 fl. drm
Treacle . . . . .	1 fl. drm.
Water . . . . .	2 fl. oz.

Mix.

2. Of Borax.

Take of—

Borax . . . . .	$\frac{1}{2}$ oz.
Tincture of myrrh . . . . .	1 fl. oz.
Water . . . . .	10 $\frac{1}{2}$ fl. oz.

Mix.

## 3. Of Chlorinated Soda.

Take of—

Solution of chlorinated soda	1 fl. oz.
Water	11 fl. oz.
Mix.	

## 4. Of Tannic Acid.

Take of—

Tannic acid	60 grs.
Treacle	2 fl. drms.
Water	4 fl. oz.
Mix.	

## 5. Of Alum.

Take of—

Alum.	60 grs.
Dilute sulphuric acid	1 fl. drm.
Treacle	4 fl. drms.
Water	15 fl. oz.
Mix.	

## INFUSIONS.

1. Of Buchu		} British Pharma- copœia.
2. „ Calumba		
3. „ Chamomile		
4. „ Cascarilla		
5. „ Catechu		
6. „ Chiretta		
7. „ Digitalis		
8. „ Gentian (Comp.)		
9. „ Linseed		
10. „ Quassia		
11. „ Senna		
12. „ Yellow Bark		

## INHALATIONS.

## 1. Of Hydrocyanic Acid.

Take of—

Dilute hydrocyanic acid	10 to 15 min.
Hot water	10 fl. oz.
Mix. Put into an inhaler.	

## 2. Of Turpentine.

Take of—

Oil of turpentine	1 fl. oz.
Hot water	4 fl. oz.
Mix. Put into an inhaler.	

## INJECTIONS.

## 1. Of Nitrate of Silver.

Take of—

Nitrate of silver	1½ grs.
Distilled water.	1 fl. oz.
Mix.	

## 2. Of Lime Water with Lead.

Take of—

Solution of subacetate of lead.	3 min.
Olive oil	2 fl. drms.
Lime water.	1 fl. oz.
Mix.	

## 3. Of Sulphate of Zinc.

Take of—

Sulphate of zinc	3 grs.
Solution of subacetate of lead	20 min.
Distilled water	1 fl. oz.
Mix.	

## LOTIONS.

## 1. Of Hydrocyanic Acid.

Take of—

Dilute hydrocyanic acid	4 fl. drms.
Acetate of lead	15 grs.
Rectified spirit	4 fl. drms.
Water.	7 fl. oz.
Mix.	

## 2. Of Creasote.

Take of—

Creasote	1 fl. drm.
Glycerine	3 fl. oz.
Water	9 fl. oz.
Mix.	

## 3. Of Nitro-Hydrochloric Acid.

Take of—

Nitric acid	3 min.
Hydrochloric acid	6 min.
Water	1 fl. oz.
Mix.	



4. Of Carbonate of Potash.

Take of—  
Carbonate of potash . . . 24 grs.  
Water . . . 1 fl. oz.  
Mix.

5. Of Sulphurous Acid.

The solution of sulphurous acid is made by passing a stream of the gas through water to saturation.

Take of—  
This solution . . . 2 fl. oz.  
Water . . . 6 fl. oz.  
Mix.

6. Of Borax and Glycerine.

Take of—  
Borax . . . 20 grs.  
Glycerine . . . 1 fl. oz.  
Water . . . 8 fl. oz.  
Mix.

7. Of Arnica.

Take of—  
Tincture of arnica . . . 1½ fl. drms.  
Water . . . 4½ fl. drms.  
Mix.

8. Of Subacetate of Lead.

Take of—  
Solution of subacetate of lead . 2 fl. drms.  
Glycerine . . . 2 fl. oz.  
Water . . . 10 fl. oz.  
Mix.

9. Of Chlorinated Lime.

Take of—  
Solution of chlorinated lime . . 18 min.  
Water . . . 6 fl. oz.  
Mix.

10. Of Corrosive Sublimate and Lime Water (Yellow Wash).

Take of—  
Corrosive sublimate . . . 1 gr.  
Lime water . . . 1 fl. oz.  
Mix.

11. Of Calomel and Lime Water (Black Wash).

Take of—  
Calomel . . . 3 grs.  
Lime water . . . 1 fl. oz.  
Mix.

12. Of Sulphate of Zinc and Lavender (Red Wash).

Take of—  
Sulphate of Zinc . . . 1 gr.  
Comp. tincture of lavender . . 15 min.  
Water . . . 1 fl. oz.  
Mix.

13. Of Sulphate of Zinc.

Take of—  
Sulphate of zinc . . . 1 gr.  
Water . . . 1 fl. oz.  
Mix.

FREEZING MIXTURES.

No. 1.

Sal-ammoniac, 5 parts. } Thermometer  
Nitre . . . 5 " } sinks from  
Water . . . 16 " } 50° to 10°  
Mix. } Fahr.

No. 2.

Snow . . . } Thermometer  
Common salt . . . } sinks from  
32° to 0°  
Mix. } Fahr.

LINIMENTS.

1. Of Aconite . . . }  
2. " Ammonia . . . }  
3. " Lime . . . }  
4. " Belladonna . . . }  
5. " Camphor (comp.) . . . }  
6. " Cantharides . . . }  
7. " Chloroform . . . }  
8. " Mercury . . . }  
9. " Opium . . . }  
10. " Soap . . . }  
11. " Turpentine . . . }  
12. " Iodine . . . }  
British  
Pharma-  
copœia.

## 13. Of Croton Oil.

Take of—	
Croton oil . . . . .	1 fl. drms.
Comp. camphor liniment . . . . .	7 fl. drms.
Mix.	

## 14. Of Belladonna and Opium.

Take of—	
Extract of belladonna . . . . .	120 grs.
Tincture of opium . . . . .	2 fl. oz.
Glycerine . . . . .	3 fl. oz.
Water . . . . .	2 fl. oz.
Mix.	

## 15. Of Sulphuret of Lime.

Take of—	
Quick lime . . . . .	1 part.
Sublimed sulphur . . . . .	2 parts.
Water . . . . .	10 parts.
Mix.	

Boil, constantly stirring with a piece of wood, until the lime and sulphur are *perfectly combined*. Decant, and keep in a well-stoppered bottle.

Wash the body well with warm water, and then rub the liquid into the skin for half an hour. For Psora.

## MIXTURES (Alterative and Resolvent).

## 1. Of Iodide of Potassium.

Take of—	
Iodide of potassium . . . . .	20 grs.
Distilled water . . . . .	6 fl. oz.
Mix. Dose, an ounce.	

## 2. Of Iodide of Potassium and Sarsaparilla.

Take of—	
Iodide of potassium . . . . .	20 grs.
Comp. decoct. of sarsaparilla . . . . .	1 O.
Mix. Dose, 4 fl. oz.	

## 3. Of Quinia and Arsenic.

Take of—	
Sulphate of quinia . . . . .	1 drms.
Arsenical solution . . . . .	2 fl. drms.
Dilute sulphuric acid . . . . .	1 fl. drms.
Tincture of bark . . . . .	2 fl. oz.
Tincture of ginger . . . . .	½ fl. drms.
Refined sugar . . . . .	20 grs.
Mix. Dose, 1 fl. dram, after meals.	

## MIXTURES (Alterative).

## 1. Of Chlorate of Potash and Bark.

Take of—	
Chlorate of potash . . . . .	90 grs.
Compound tincture of cinchona . . . . .	6 fl. drms.
Infusion of yellow cinchona . . . . .	6 fl. oz.
Mix. Dose, an ounce.	

## 2. Of Nitro-Hydrochloric Acid.

Take of—	
Dil. nitric acid . . . . .	½ fl. drms.
Dil. hydrochloric acid . . . . .	1 fl. drms.
Infusion of quassia . . . . .	6 fl. oz.
Mix. Dose, an ounce.	

## 3. Of Bromide of Potassium.

Take of—	
Bromide of potassium . . . . .	24 grs.
Water . . . . .	7 fl. oz.
Mix. Dose, an ounce.	

## 4. Of Turpentine.

Take of—	
Oil of turpentine . . . . .	1 fl. oz.
Yolk of one egg.	
Mix well, and add gradually	
Mucilage of gum arabic . . . . .	2 fl. drms.
Tincture of orange peel . . . . .	2 fl. drms.
Compound tincture of lavender . . . . .	4 fl. drms.
Water . . . . .	5½ fl. oz.
Mix. Dose, half an ounce.	

5. Of Soda and Gum Arabic.

Take of—

Mucilage of gum arabic	. . .	½ fl. oz.
Tincture of hyoscyamus	. . .	1½ fl. drm.
Bicarbonate of soda	. . .	90 grs.
Water	. . .	8 fl. oz.

Mix. Dose, an ounce.

MIXTURES (Sedative).

1. Of Hydrocyanic Acid and Soda.

Take of—

Dilute hydrocyanic acid	. . .	18 min.
Bicarbonate of soda	. . .	90 grs.
Water	. . .	6 fl. oz.

Mix. Dose, an ounce.

MIXTURES (Antacid).

1. Of Ammonia and Bark.

Take of—

Carbonate of ammonia	.. .	60 grs.
Chlorate of potash	. . .	120 grs.
Decoction of bark	. . .	12 fl. oz.

Mix. Dose, an ounce.

2. Of Bismuth and Gentian.

Take of—

White bismuth	. . .	42 grs.
Dilute hydrocyanic acid	. . .	30 min.
Mucilage of gum arabic	. . .	½ fl. oz.
Infusion of gentian	. . .	6 fl. oz.

Mix. Dose, half an ounce.

MIXTURES (Antispasmodic).

1. Of Lobelia and Ether.

Take of—

Etherial tincture of lobelia	. . .	3 fl. drms.
Camphor water	. . .	5½ fl. oz.

Mix. Dose, an ounce.

2. Of Ammonia in effervescence.

Take of—

Carbonate of ammonia	. . .	90 grs.
Water	. . .	3 fl. oz.

Mix. Dose, an ounce, with 18 grs. of citric acid.

3. Of Spirit of Chloroform (Chloric Ether).

Take of—

Spirit of chloroform	. . .	2 fl. drms.
Syrup of squills	. . .	3 fl. drms.
Tincture of opium	. . .	20 min.
Water	. . .	6 fl. oz.

Mix. Dose, an ounce.

MIXTURES (Astringent).

1. Of Bismuth.

Take of—

White bismuth	. . .	1 drm.
Mucilage of gum arabic	. . .	3 fl. oz.
Water	. . .	3 fl. oz.

Mix. Dose, an ounce.

2. Of Chalk and Opium.

Take of—

Tincture of catechu	. . .	3 fl. drms.
Aromatic confection	. . .	90 grs.
Tincture of opium	. . .	30 min.
Chalk mixture	. . .	6 fl. oz.

Mix. Dose, an ounce.

3. Of Gallic Acid.

Take of—

Gallic acid	. . .	40 grs.
Camphorated tinc. of opium	. . .	2½ fl. drms.
Dilute sulphuric acid	. . .	1 fl. drm.
Water	. . .	8 fl. oz.

Mix. Dose, an ounce.

4. Of Tannic Acid.

Take of—

Tannic acid	. . .	40 grs.
Dilute nitric acid	. . .	½ fl. drm.
Treacle	. . .	2 fl. drms.
Infusion of gentian	. . .	8 fl. oz.

Mix. Dose, an ounce.

## 5. Of Nitric Acid.

Take of—

Dilute nitric acid . . .	1½ fl. drm.
Infusion of cascarrilla . . .	8 fl. oz.
Mix. Dose, an ounce.	

## 6. Of Logwood.

Take of—

Lime water . . .	2 fl. oz.
Decoction of logwood . . .	6 fl. oz.
Mix. Dose, an ounce.	

## 7. Of Creasote.

Take of—

Creasote . . .	16 min.
Glacial acetic acid . . .	16 min.
Spirit of juniper . . .	½ fl. drm.
Syrup . . .	1 fl. oz.
Distilled water . . .	15 fl. oz.

Mix the creasote with the acetic acid, gradually add the water, and lastly the syrup and spirit of juniper.

Dose, one or two ounces.

## 8. Of Sulphuric Acid, Alum, and Magnesia.

Take of—

Dilute sulphuric acid . . .	2 fl. drms.
Alum . . .	80 grs.
Sulphate of magnesia . . .	½ oz.
Water . . .	8 fl. oz.

Mix. Dose, an ounce.

## MIXTURES (Cathartic and Anthelmintic).

## 1. Of Magnesia and Antimony.

Take of—

Sulphate of magnesia . . .	1 oz.
Antimonial wine . . .	1 fl. drm.
Syrup of poppies . . .	3 fl. drms.
Solution of acetate of ammonia . . .	2 fl. drms.
Camphor mixture . . .	5 fl. oz.

Mix. Dose, an ounce.

## 2. Of Magnesia and Sulphuric Acid.

Take of—

Sulphate of magnesia . . .	1 oz.
Dilute sulphuric acid . . .	1 fl. drm.
Treacle . . .	1 fl. oz.
Peppermint water . . .	8 fl. oz.

Mix. Dose, an ounce.

## 3. Of Magnesia and Senna.

Take of—

Sulphate of magnesia . . .	1 oz.
Tincture of ginger . . .	2 fl. drms.
Aromatic spirit of ammonia . . .	2 fl. drms.
Tincture of senna . . .	½ fl. oz.
Infusion of senna . . .	8 fl. oz.

Mix. Dose, an ounce.

## MIXTURES (Diaphoretic).

## 1. Of Acetate of Ammonia.

Take of—

Solution of acetate of ammonia . . .	2 fl. drms.
Tartarated antimony . . .	½ gr.
Spirit of nitrous ether . . .	2 fl. drms.
Water . . .	7 fl. oz.

Mix. Dose, an ounce.

## 2. Of Potash and Magnesia.

Take of—

Nitrate of potash . . .	30 grs.
Sulphate of magnesia . . .	1½ oz.
Tincture of hyoscyamus . . .	1 fl. drm.
Mucilage of gum arabic . . .	1 fl. oz.
Water . . .	8 fl. oz.

Mix. Dose, an ounce.

## MIXTURES (Diuretic).

## 1. Of Acetate of Potash.

Take of—

Acetate of potash . . .	90 grs.
Syrup of squills . . .	1½ fl. drms.
Decoction of broom . . .	8 fl. oz.

Mix. Dose, an ounce.

## 2. Of Nitrate of Potash and Buchu.

Take of—

Nitrate of potash	. . . 30	grs.
Spirit of nitrous ether	. . . $\frac{1}{2}$	fl. oz.
Compound spirit of juniper.	3	fl. drms.
Infusion of buchu	. . . 7	fl. oz.

Mix. Dose, half an ounce.

## MIXTURES (Expectorant).

### 1. Of Squills and Conium.

Take of—

Tincture of squills	. . . 80	min.
Solution of potash	. . . 1	fl. drms.
Juice of conium	. . . $1\frac{1}{2}$	fl. drms.
Camphor water	. . . 8	fl. oz.

Mix. Dose, an ounce.

### 2. Of Senega.

Take of—

Camphorated tincture of opium	4	fl. drms.
Tincture of tolu	. . . 2	fl. drms.
Refined sugar	. . . 20	grs.
Decoction of senega	. . . 7	fl. oz.

Mix. Dose, an ounce.

### 3. Of Soda and Gum Arabic.

Take of—

Bicarbonate of soda	. . . 80	grs.
Tincture of hyoscyamus	. . . 2	fl. drms.
Mucilage of gum arabic	. . . $\frac{1}{2}$	fl. oz.
Water	. . . $7\frac{1}{2}$	fl. oz.

Mix. Dose, an ounce.

### 4. Of Ipecacuan and Gum Arabic.

Take of—

Ipecacuan wine	. . . 2	fl. drms.
Mucilage of gum arabic	. . . 2	fl. oz.
Syrup of squill	. . . 3	fl. drms.
Water	. . . $7\frac{1}{2}$	fl. oz.

Mix. Dose, an ounce.

## 5. Of Ipecacuan and Opium.

Take of—

Wine of ipecacuan	. . . 2	fl. drms.
Tincture of opium	. . . 40	min.
Nitrate of potash	. . . 80	grs.
Mucilage of gum arabic	. . . $\frac{1}{2}$	fl. oz.
Water	. . . 8	fl. oz.

Mix. Dose, an ounce.

## 6. Of Hydrocyanic Acid and Morphia.

Take of—

Dilute hydrocyanic acid	. . . 4	min.
Solution of hydrochlorate of morphia	. . . 15	min.
Treacle	. . . 4	fl. drms.
Water	. . . 6	fl. oz.

Mix. Dose, half an ounce.

## MIXTURES (Stimulant).

### 1. Of Citrate of Potash and Calumba.

Take of—

Bicarbonate of potash	. . . 120	grs.
Aromatic spirit of ammonia.	$1\frac{1}{2}$	fl. drms.
Spirit of chloroform	. . . 1	fl. drms.
Dilute hydrocyanic acid	. . . 25	min.
Tincture of calumba	. . . 6	fl. drms.
Infusion of calumba	. . . 12	fl. oz.

Mix. Dose, two ounces, with one of lemon juice, or with 14 grs. of citric acid.

### 2. Of Ammonia and Cascarilla.

Take of—

Carbonate of ammonia	. . . 30	grs.
Infusion of cascarrilla	. . . 6	fl. oz.

Mix. Dose, an ounce.

### 3. Of Taraxacum.

Take of—

Extract of taraxacum	. . . 180	grs.
Dilute nitric acid	. . . 40	min.
Water	. . . 8	fl. oz.

Mix. Dose, an ounce.

**MIXTURES (Tonic).****1. Of Nux Vomica.**

Take of—

Tincture of nux vomica . . . 1 fl. drm.

Infusion of gentian . . . 8 fl. oz.

Mix. Dose, an ounce.

**2. Of Perchloride of Iron.**

Take of—

Solution of perchloride of iron. 1 fl. drm.

Hydrochlorate of ammonia . 60 grs.

Water . . . . . 6 fl. oz.

Mix. Dose, an ounce.

**3. Of Iron and Calumba.**

Take of—

Citrate of iron and ammonia . 30 grs.

Infusion of calumba . . . 6 fl. oz.

Mix. Dose, an ounce.

**4. Of Iron and Quinia.**

Take of—

Citrate of iron and quinia . . 60 grs.

Water . . . . . 6 oz.

Mix. Dose, half an ounce to an ounce.

**OINTMENTS.**

- |                                      |                                  |
|--------------------------------------|----------------------------------|
| 1. Of Aconite . . . . .              | } British<br>Pharma-<br>copoeia. |
| 2. " Tartarated Antimony . . . . .   |                                  |
| 3. " Atropia . . . . .               |                                  |
| 4. " Belladonna . . . . .            |                                  |
| 5. " Creasote . . . . .              |                                  |
| 6. " Galls . . . . .                 |                                  |
| 7. " Red Iodide of Mercury . . . . . |                                  |
| 8. " Nitrate of Mercury . . . . .    |                                  |
| 9. " Mercury . . . . .               |                                  |
| 10. " Red Oxide of Mercury . . . . . |                                  |
| 11. " Subacetate of Lead . . . . .   |                                  |
| 12. " Simple Ointment . . . . .      |                                  |

**PIGMENTS.****1. Of Iodine.**

Take of—

Iodine . . . . . 60 grs.

Iodide of potassium . . . 40 grs.

Rectified spirit . . . . . 1 fl. oz.

Mix.

**2. Of Iodine (Weaker).**

Take of—

Iodine . . . . . 30 grs.

Iodide of potassium . . . 20 grs.

Rectified spirit . . . . . 1 fl. oz.

Mix.

**PILLS (Astringent and Anti-spasmodic).****1. Of Gallic Acid and Morphia.**

Take of—

Gallic acid . . . . . 2½ grs.

Hydrochlorate of morphia . . ⅙ gr.

Mucilage of gum arabic . . . q. s.

Mix. Make a pill.

**2. Of Copper and Opium.**

Take of—

Sulphate of copper . . . . . ¼ gr.

Opium in powder . . . . . ¼ gr.

Confection of roses . . . . . q. s.

Mix. Make a pill.

**3. Of Lead and Opium.**

Take of—

Acetate of lead . . . . . 1 gr.

Opium, in fine powder . . . ⅓ gr.

Confection of roses . . . . . q. s.

Mix. Make a pill.

**PILLS (Cathartic).**

**1. Of Colocynth, Scammony, and Calomel.**

Take of—

Compound colocynth pill . . .	3 grs.
Scammony, in powder . . .	3 grs.
Oil of cinnamon, . . .	2 min.
Calomel . . .	3 grs.

Mix. Divide into two pills. Two for a dose.

**2. Of Colocynth and Croton Oil.**

Take of—

Compound pill of colocynth . . .	26 grs.
Compound pill of gamboge . . .	12 grs.
Capsicum . . .	6 grs.
Croton oil. . .	1 min.

Mix. Make twelve pills. One for a dose.

**3. Of Rhubarb and Mercury.**

Take of—

Compound pill of rhubarb . . .	4 grs.
Mercurial pill . . .	1 gr.

Mix. Make one pill.

**4. Of Podophyllum.**

Take of—

Resin of podophyllum in fine powder . . .	1 gr.
Extract of hyoscyamus . . .	6 grs.
Extract of liquorice . . .	5 grs.

Mix. Make four pills. One for a dose.

**PILLS (Alterative).**

**1. Of Aloes and Myrrh.**

Take of—

Pill of aloes and myrrh . . .	2½ grs.
Compound assafetida pill . . .	2½ grs.

Mix. Make one pill.

**PILLS (Diuretic).**

**1. Of Squill and Ipecacuan.**

Take of—

Compound squill pill. . .	2½ grs.
Powder of ipecacuan and opium. . .	2½ grs.
Treacle . . .	q. s.

Mix. Make one pill.

**2. Of Elaterium.**

Take of—

Elaterium in fine powder . . .	10 gr.
Extract of hyoscyamus . . .	1 gr.
Extract of gentian . . .	3 grs.

Mix. Make one pill.

**3. Of Squill and Digitalis.**

Take of—

Squill, in fine powder . . .	2 grs.
Extract of conium . . .	2 grs.
Digitalis, in powder . . .	1 gr.

Mix. Make one pill.

**PILLS (Sedative).**

**1. Of Conium and Morphia.**

Take of—

Extract of conium . . .	4 grs.
Ipecacuan, in powder. . .	½ gr.
Hydrochlorate of morphia . . .	½ gr.

Mix. Make one pill.

**2. Of Squill and Morphia.**

Take of—

Squill, in powder . . .	2 grs.
Hydrochlorate of morphia . . .	½ gr.
Ipecacuan, in powder . . .	½ gr.

Mix. Make one pill.

**3. Of Stramonium.**

Take of—

Extract of stramonium . . .	½ gr.
Extract of liquorice . . .	3 grs.

Mix. Make one pill.



## 4. Of Oxide of Zinc.

Take of—

Oxide of zinc, in fine powder	. 2½ grs.
Extract of liquorice	. 2 grs.
Mix.	Make one pill.

## 5. Of Zinc and Hyoscyamus.

Take of—

Oxide of zinc, in fine powder	. 2 grs.
Extract of hyoscyamus	. 2 grs.
Mix.	Make one pill.

## PLASTERS.

1. Ammonia and Mercury	. . . . .	} British Pharma- copœia.
2. Belladonna	. . . . .	
3. Warm Plaster	. . . . .	
4. Iron	. . . . .	
5. Galbanum	. . . . .	
6. Mercury	. . . . .	
7. Opium	. . . . .	
8. Pitch	. . . . .	
9. Soap	. . . . .	

## POWDERS.

## 1. Of Soda and Potash (in effervescence).

Take of—

Tartrate of soda and potash	. 120 grs.
Bicarbonate of soda	. 40 grs.
Mix.	In a separate paper 37 grs. of tartaric acid.

## 2. Of Calomel and Jalap.

Take of—

Calomel	. . . . .	4 grs.
Jalap.	. . . . .	15 grs.
Ginger	. . . . .	2 grs.
Sugar	. . . . .	2 grs.

Mix. One for a dose.

## 3. Of Ipecacuan and Antimony.

Take of—

Ipecacuan, in powder	. . . . .	20 grs.
Tartarated antimony	. . . . .	1 gr.

Mix. One for a dose.

## 4. Of Galls and Tannic Acid.

Take of—

Galls, in powder	. . . . .	8 grs.
Tannic acid	. . . . .	1 gr.
Bicarbonate of soda	. . . . .	1 gr.

Mix. One for a dose.

## 5. Of Kino and Alum.

Take of—

Powder of kino and opium	. . . . .	5 grs.
Alum	. . . . .	2 grs.

Mix. One for a dose.

## SUPPOSITORIES.

## 1. Of Opium.

Take of—

Opium, in powder	. . . . .	2 grs.
Hard soap	. . . . .	20 grs.

Mix.

# INDEX.

## A.

ABDOMEN, wounds of, 96.  
 Acid, nitric, as a dressing, 50.  
 Accommodation for wounded, 15.  
 Accompanying troops into action, 13.  
 Acupressure, 207.  
 Affections of stumps, 198.  
 Aitken's, Professor, definition of pyæmia, 240.  
 Alcock on gun-shot fractures of the thigh, 123.  
     " on wounds of joints, 140.  
     " on periods for amputation, 154.  
 Alcohol as a dressing, 51.  
 Anæsthesia, 151.  
 American treatment of chest wounds, 83.  
 Amputation for tetanus, 225.  
     " proper periods for, 153.  
     " cases demanding it, 157.  
     " different methods, 160.  
     " double, 158.  
     " at the shoulder-joint, 161.  
     " of the arm, 164.  
     " of the arm above elbow, 164.  
     " through the elbow-joint, 165.  
     " of the forearm, 165.  
     " at the wrist-joint, 167.  
     " of metacarpal bones, 168.  
     " of index and little fingers, 168.  
     " of a whole finger, 169.  
     " through the second phalanx, 169.  
     " of a distal phalanx, 169.  
     " at the hip-joint (Lisfranc's), 169.  
     " do. do. (Guthrie's), 170.  
     " do. do. (Fergusson's), 171.  
     " of the thigh, similar to Ver-  
     mal's, 174.

Amputation of the thigh by the antero-  
     posterior flap operation, 173.  
     " through the condyles of the  
     femur (Syme's), 175.  
     " through the condyles of the  
     femur (Carden's), 175.  
     " through the knee, with anterior  
     and posterior flaps, 175.  
     " of the leg through the calf, 177.  
     " by a single flap, 177.  
     " by the circular  
     method, 177.  
     " at the ankle-joint (Syme's), 177.  
     " through the tarsus (Chopart's),  
     179.  
     " of all the metatarsal bones  
     (Hey's), 179.  
     " of metatarsal bone of the great  
     toe, 180.  
     " of metatarsal bone of little  
     toe, 180.  
     " of the distal phalanx of the  
     great toe, 180.  
     " of lesser toes, second, third, and  
     fourth, 180.  
     " by Teal's method, 181.  
 Aneurism, traumatic, 208.  
     " diffused, 208.  
     " circumscribed, 208.  
 Aneurismal enlargement of stumps, 198.  
     " varix, 209  
 Ankle, amputation at, 178.  
     " excision of, 192.  
     " wounds of, 148.  
 Antiseptics, 267.  
 Anterior splints, N. R. Smith's, 131.  
 Anus, artificial, 106.  
     " wounds of, 114.

Appareil Bonnet, 134.  
 Appia's fracture apparatus, 33.  
 Arm, fractures of, 117.  
 " amputation of, 164.  
 Arnica as a dressing, 51.  
 Arrow wounds, 52.  
 " heads, extraction of, 53.  
 Artificial anus, 106.  
 Arteries of neck, wounds of, 77.  
 " Velpeau's opinion on, 201.  
 " punctured, 208.  
 " wounded, 199.  
 " torsion of, 206.  
 " ligature of, 210.  
 Astragalus, excision of, 194.  
 Atropine in wounds of the eye, 74.

## B.

BAKER, A. E., on tetanus, 231.  
 Ball, velocity of, influencing a wound, 44.  
 Bandages, 17, 45.  
 " flannel, 13.  
 " insufficient supply of, 17.  
 " each soldier to carry one, 17.  
 " Esmarch's, 17.  
 Barns to accommodate wounded, 15.  
 Ballingall on wounds of the intestines, 102.  
 " " lungs, 83.  
 Barton on bran for putting up fractures, 139.  
 Baths, 267.  
 " for wounds, Esmarch's, 46.  
 Bayonet wounds, 52.  
 " for an extemporary splint, 22.  
 Base of the skull, fracture of, 57.  
 Bavarian method of plaster of Paris bandage, 30.  
 Beef, essence of, for wounded, 13.  
 " tea for wounded, 17.  
 Belts for extemporary stretchers, 7.  
 Bell on wounds of the intestines, 100.  
 Bed sores, 220.  
 Belladonna in tetanus, 225.  
 Bill's arrow-head extractor, 53.  
 Billroth on plaster of Paris bandages, 26.  
 " duties at the bandage places, 16.  
 Birkett, J., on wounds of the pelvis, 111.  
 Blankets for extemporary stretchers, 6, 10.  
 Bladder, protrusion of, 100.

Bladder, wounds of, 113.  
 " missiles lodged in, 113.  
 Bloodless operation, 159.  
 Bloody tumours of scalp, 55.  
 Blood in cavity of chest, 81.  
 Bones, injury of, 115.  
 " excision of, 196.  
 Boots, badly fitting, 2.  
 Boards for extemporary splints, 20.  
 Box splints, for fractures of leg, 137, 139.  
 Brandy for wounded, 13.  
 Brancard (Swinburne's), 32.  
 Brain, secondary consequences in injury of, 67.  
 " inflammation of, 67.  
 " suppuration of, 67.  
 " hernia of, 67.  
 Bran for extemporary pads, 26, 139.  
 Bryant on Pirogoff's amputation, 182.  
 Brodie on extraction of bullets from skull, 62.  
 Brushwood for splints, 26.  
 Butcher's splint for excision of the knee, 190.  
 " on excision of knee, 192.  
 Bullet extractors, 42.  
 " explorers, 39.  
 " lodged in bone, 42.  
 " found near the skin, 42.  
 " wound of chest, 87.  
 " in cavity of chest, 88.  
 Bromine in hospital gangrene, 232.

## C.

CACOLETS, Appia's opinion on, 10.  
 Cacolet bed, " 10.  
 Calf of leg, amputation through, 177.  
 Candles required by surgeon, 13.  
 Cane splints, 24.  
 Cannon-shot wounds, 36.  
 Carden's amputation at the knee, 175.  
 Carded oakum as a dressing, 51.  
 Carbolyzed tow " 51.  
 Carbolyzed spray, Lister's, 158.  
 Carbolic acid as a disinfectant, 50.  
 Carts for carriage of wounded, 9.  
 Carriage of wounded on stretchers, 2.  
 Cataplasms, 268.  
 Caustics, 268.

Cauterization in hæmorrhage, 207.  
 " for hospital gangrene, 232.  
 Charpie, 51.  
 Cheeks, wounds of, 74.  
 Chest wounds, 79.  
 " penetrating, 79.  
 " use of probes in, 80.  
 " extraneous bodies in, 88.  
 Chisholm on chest wounds, 84.  
 Chisholm's treatment of gun-shot wounds, 51.  
 Chloroform, 151.  
 " in tetanus, 226.  
 Chopart's amputation, 179.  
 Churches to accommodate wounded, 15.  
 Chaff for extemporary pads or cushions, 26.  
 Chloride of lime as a disinfectant, 50.  
 " zinc " 50.  
 Classification of injuries, 258.  
 " operations, 263.  
 Clavicle, excision of, 184.  
 Collyria, 268.  
 Comforts, medical inspection of, 2.  
 Compound fractures, 115.  
 Compression of the brain, 61.  
 " spinal cord, 108.  
 Concussion of the brain, 60.  
 " spinal cord, 107.  
 Conical bullets, wounds inflicted by, 39.  
 Constitutional alarm, 16, 17, 152.  
 " treatment of wounded, 152.  
 Contre-coup, fractures by, 57.  
 Contused wounds, 38.  
 Cooper, Sir A., on depressed fracture of cranium, 56.  
 Cooper, Mr. S., on transport in fracture of the thigh, 121.  
 Cooking-places in camp, 251.  
 Cordials for wounded, 17.  
 Cork, shavings of, for extemporary pads, 26.  
 Cotton-wool for pads, 26.  
 " for dressing wounds, 52.  
 Cripps's method for bloodless operation, 160.  
 Cubic space for wounded, 51.  
 Cushions, materials for, 26.

## D.

DECOCTIONS, 269.  
 Demarquay on tetanus, 226.

Depression of cranium, 56.  
 Desault's purse, 82.  
 De Wilde's explorer, 42.  
 Diagnosing tablet or card, 15.  
 Diaphragm, wounds of, 93.  
 Diets, scale of, for fixed hospitals, 256.  
 " for wounded on the field, 255.  
 Dieulafoy's aspirator for empyema, 94.  
 Disarticulation, operation for, 157.  
 Discharge from gun-shot wounds, 44.  
 Dislocation of spine, 108.  
 Distribution of wounded, 15.  
 Disinfectants, 50.  
 Drinking-cup for wounded, 13.  
 Dress of soldier, acquaintance with, 2.  
 Draughts (antispasmodic), 269.  
 " (astringent), 269.  
 " (cathartic), 269.  
 " (antacid), 270.  
 " (anthelmintic), 270.  
 " (diaphoretic), 270.  
 Drops (eye), 270.  
 Duncan's rattan splint, 24.  
 Dupuytren on the use of probes in chest wounds, 81.  
 " on the actual cautery in hospital gangrene, 231.  
 " on classification of sequestra, 127.  
 Duties of the surgeon at first line of surgical assistance, 15.  
 Dwelling-houses for wounded, 15.

## E.

EAR, wounds of, 73.  
 Echinosis in chest wounds, 81.  
 Elbow, amputation through, 165.  
 " joint, excision of, 184.  
 " " wounds of, 143.  
 Electric explorers, 42.  
 Electuaries, 269.  
 Emphysema in wounds of the chest, 80, 89.  
 " " larynx, 77.  
 " " intestine, 97.  
 Empyema, 94.  
 Enemata (nutritive), 271.  
 " (purgative), 271.  
 " (sedative), 271.  
 Engagement, duties of surgeon after, 16.

Ergotine, Langenbeck's solution, 208.  
 Erichsen on fracture of the base of the skull, 58.  
 " on fractures of lower jaw, 73.  
 " on pleuritis in chest wounds, 86.  
 " on extraneous bodies in chest wounds, 89.  
 " on rupture of the liver, 97.  
 " on protruded intestine, 99.  
 " on indications for excision, 141.  
 " on method of stitching wounds of the intestine, 103.  
 " on injury of the spine, 107.  
 " on incisions in cellulose-cutaneous erysipelas, 237.  
 " on ligature of arteries, 210.  
 Erichsen's splint for compound fracture of the thigh, 134.  
 " " for excision of the hip-joint, 188.  
 Erysipelas, 235.  
 Esmarch's triangular bandage, 17.  
 " foot and arm baths, 46.  
 " irrigator, 47.  
 " splint for fracture of the thigh, 133.  
 " splint for excision of the elbow, 143.  
 " splint for excision of the wrist, 144.  
 " splint for excision of the ankle, 195.  
 " bloodless operation, 159.  
 " tourniquet, 204.  
 Essence of beef for wounded, 13.  
 Excisions, indications for, 141.  
 Excision of the ankle, 192.  
 " of the astragalus, 194.  
 " of the clavicle, 184.  
 " of the elbow-joint, 184.  
 " of the eye, 197.  
 " of the carpal ends of the bones of forearm, 185.  
 " of the knee-joint, 189.  
 " of the head of the humerus, 183.  
 " of the head of the femur, 187.  
 " of the os calcis, 194.  
 " of the scapula, 184.  
 " of shaft of bones, 196.  
 " of tarsal bones, 195.

Excision of the wrist, 185.  
 " of the wrist (Lister's method), 186.  
 Exfoliation of bone in stumps, 198  
 Examination of wounded, 15, 39.  
 Extemporary transport, 6.  
 " splints, 19, 26.  
 " filters, 254.  
 " pads and cushions, 26.  
 " tourniquets, 204.  
 Extraneous bodies in wounds, 39.  
 Extractors of bullets, 42.  
 Explorers of bullets, 41.  
 Extremities, wounds of, 115.  
 Eye, wounds of, 74.  
 Eyelids, wounds of, 73.  
 Eyeball, excision of, 197.

## F.

FACE, wounds of, 70.  
 Fayrer on tetanus, 226.  
 " on osteo-myelitis, 245, 246, 248.  
 Femur, gun-shot fractures of, 121.  
 " Hamilton's method of treating, 129.  
 " Stromeyer's ditto, 123.  
 " Pirogoff's ditto, 124.  
 " Guthrie's ditto, 128.  
 " Hodgen's ditto, 129.  
 " Smith's, Nathan, ditto, 131.  
 " Esmarch's ditto, 133.  
 " Erichsen's ditto, 134.  
 " Sarazin's ditto, 136.  
 " Hennen's opinion on gun-shot fractures of, 122.  
 " Alcock's ditto, 123.  
 Field, preparations for, 13.  
 Filters, 254.  
 Fingers, wounds of, 120.  
 " amputation of, 168.  
 First line of surgical assistance, 13.  
 " wounded to be relieved, 16.  
 Fomentations, 271.  
 Foot, disarticulation of, 177.  
 Footsoreness, 250.  
 Foot, wounds of, 149.  
 Forearm, wounds of, 120.  
 " amputation of, 165.  
 Foreign bodies in chest, 87.  
 Formulary of prescriptions, 267.

Fractures at first line of surgical assistance, 15.

Fractures of the upper extremities, 22, 117.

“ of the lower extremities, 19, 121.

“ of the cranium, 62.

“ of the base of the skull, 57.

“ of the spine, 108.

“ of the humerus, 117.

“ of the radius, 120.

“ of the femur, 121.

“ of tibia and fibula, 137.

“ partial, 116.

Fraser on inflammation of the lungs, 86.

Freezing mixtures, 273.

Frost-bites, amputation in, 220.

Fuel required for wounded, 15.

Fungus cerebri, 67.

## G.

GANGRENE, 218.

Gangrene of the lung, 91.

“ intestine, 100.

Gangrene, hospital, 228.

Gargles, 271.

Genitals, wounds of, 114.

Glycerine as a dressing, 51.

Goldsmith on the use of bromine in hospital gangrene, 232.

Gooch's splint for excision of the knee, 191.

Gordon, C. A., on wounds of the knee-joint, 147.

“ on wound of the chest, 87.

“ on Swinburne's brancard, 32.

“ on silicate of potash bandages, 25.

“ description of “appareil Bonnet,” 134.

Gosselin on septicæmia, 243.

Great-coats for extempore stretchers, 8.

Gross's method for excision of hip, 187.

Guérin on treatment of wounds, 52.

Gun-shot wounds, 44.

“ treatment of, 45.

Guthrie on bandages, 45.

“ on excision of the ankle-joint, 193.

“ on depressed fractures of the cranium, 62.

on wounds of eyelids, 74.

Guthrie on wounds of lungs, 83.

“ on hernia of lung, 91.

“ on protrusion of omentum, 99.

“ on wounds of intestine, 102.

“ on balls in pelvis, 112.

“ on fractures of the thigh, 128.

“ on fractures of the humerus, 117.

“ on wounds of the hip-joint, 145.

Gutta-percha splints, 23, 71.

## H.

HÆMORRHAGE, primary, 199.

“ intermediary, 201.

“ secondary, 201.

“ parenchymatous, 201.

“ cases of, to be first relieved, 16.

“ in chest wounds, 81.

“ in abdominal wounds, 93.

“ from compound fracture of the leg, 139.

“ from stumps, 201.

“ venous, 208.

“ means for suppressing, 203.

Hamilton, U.S.A., on salivation, 72.

“ on wounds of the head of the femur, 145.

“ on gun-shot fractures of the femur, 125, 129.

“ on ditto of the leg, 138.

“ on bromine in hospital gangrene, 232.

“ on bandages, 45.

Hammocks for transport, 6, 14.

Hand, wounds of, 120.

Hannover, Professor, on resection, 141.

Hay ropes for stretchers, 7.

Head injuries, 55.

Heart wounds, 92.

Hennen on wounds of cranium, 62.

“ on hæmorrhage from lungs, 83.

“ on gun-shot fractures of thigh, 122.

“ on wounds of the hip-joint, 145.

“ on hospital gangrene, 228.

Hermetically sealing wounds of chest, 87.

Hernia of the lung, 91.

“ brain, 67.

Hey's amputation, 179.

Hip-joint, injuries of, 145.

Hip-joint, amputation at, 169.  
 " excision of, 187.  
 Hodgen's splints, 129.  
 Hollow bullet, effects of, 39.  
 Holston on the use of the trephine, 63.  
 Holston's chisel, 64.  
 Horn shavings for pads, 26.  
 Hospital gangrene, 228.  
 Howard on hermetically sealing wounds, 87.  
 Humerus, injuries of head of, 142.  
 " excision of head of, 183.  
 " gun-shot fractures, 117.  
 Hunter on the use of probes, 39.  
 " on gun-shot wounds, 44.  
 Hydrothorax, 95.  
 Hypodermic syringes, 17.  
 Hypodermic injections of morphia, 17.  
 " " ergotine, 208.

## I.

ICE for wounds, 45.  
 " in hæmorrhage, 207.  
 Incised wounds, 37.  
 Inflammation of the brain, 67.  
 " of stumps, 198.  
 Infusions, 272.  
 Inhalations, 272.  
 Injections, 272.  
 Injuries of the head, 55.  
 Instruments, preservation of, 2.  
 Intercostal arteries, hæmorrhage from, 82.  
 Intestines, wounds of, 100.  
 Iodine as a disinfectant, 51.  
 Iron perchloride, 208.  
 Iron, persulphate of, in hæmorrhage, 207.  
 Irrigation, 48.

## J.

JAW, lower, wounds of, 71.

## K.

KIDNEY, rupture of, 97.  
 Kitchens in camp, 251.  
 Knapsacks for stretchers, 11.  
 " for splints, 20.

Knapsack boards for splints, 21.  
 Knee-joint, wounds of, 146.  
 " incised wounds of, 148.  
 " amputation through, 175.  
 " excision of, 189.  
 Knot, reef, 210.

## L.

LACHRYMAL bones and sac, 75.  
 Lacerated wounds, 37.  
 Ladder as a stretcher, 10.  
 Lance wounds, 52.  
 Lances for stretchers, 10.  
 Langenbeck on wounds of the ankle-joint, 148.  
 " on wounds of the knee-joint, 148.  
 " on ergotine in hæmorrhage, 208.  
 Larynx, wounds of, 77.  
 Laths for extemporary splints, 26.  
 Latrines, 253.  
 Leather for splints, 26.  
 Lecomte's probe, 41.  
 Leg, fractures of, 137.  
 " amputation of, 176.  
 " extemporary splints for, 20.  
 Legouest on the use of the trephine, 65.  
 " on wounds of the hip-joint, 146.  
 " " knee-joint, 147.  
 " on indications for excision, 142.  
 Ligature, application of, 210.  
 " of aorta, 216.  
 " axillary artery, 212.  
 " brachial artery, 213.  
 " common carotid artery, 211.  
 " external carotid artery, 211.  
 " gluteal artery, 214.  
 " common iliac artery, 214.  
 " external iliac artery, 214.  
 " internal iliac artery, 214.  
 " innominata artery, 211.  
 " lingual artery, 211.  
 " subclavian artery, 211.  
 " radial artery, 213.  
 " popliteal artery, 215.  
 " peroneal artery, 216.  
 " anterior tibial artery, 216.  
 " posterior tibial artery, 216.



Ligature of ulnar artery, 213.  
 Lime, chloride of, as a disinfectant, 50.  
 Liniments, 273.  
 Lint, each soldier to carry a piece, 17.  
 Lisfranc's amputation at hip-joint, 169.  
 Lister on excision of wrist, 186.  
 Lister's carbolic spray, 158.  
 Liston on tetanus, 225.  
 Lithotomy, operation of, 217.  
 Lœffler on resection of joints, 141.  
 Longmore's explorer, 42.  
 Longmore, Prof., on carriage of stretchers, 3.  
 " wind balls, 38.  
 " exploring wounds, 40.  
 " the use of the trephine, 63.  
 " hæmorrhage from the lungs, 83.  
 " wounds of the intestine, 102.  
 " partial fractures, 116.  
 " wounds of the knee-joint, 146.  
 " gun-shot fractures of the femur, 123.  
 " osteo-myelitis, 245, 247.  
 Liebreich's explorer, 42.  
 Lungs, wounds of, 80.  
 " hæmorrhage from, 82.  
 " hernia of, 91.

## M.

MACCORMAC on torsion of arteries, 206.  
 " on Stromeyer's pad, 118.  
 " on Esmarch's splint for resection of wrist, 144.  
 " on pyæmia, 242.  
 Macdonald's ambulance lift, 14.  
 Macleod on hæmorrhage from the lungs, 83.  
 " on fractures of femur, 125.  
 " on wounds of the knee-joint, 146.  
 Maggots in stumps, 159.  
 Manley on extemporary transport, 12.  
 Mariner's compass for exploring, 42.  
 Metatarsal bones, amputation of, 179.  
 " bone, great toe, removal of, 180.  
 " bone, little toe, removal of, 180.  
 Mixtures, alterative, 274.  
 " sedative, 275.  
 " antacid, 275.  
 " antispasmodic, 275.  
 " astringent, 275.  
 " cathartic, 276.

Mixtures, diaphoretic, 276.  
 " diuretic, 276.  
 " expectorant, 277.  
 " stimulant, 277.  
 Moffitt's plaster of Paris bandage, 27.  
 Moore, Sanford, on pyæmia, 240.  
 Mott's tourniquet, 204.  
 Morgan's ether inhaler, 152.  
 Morphia for relief of wounded, 17, 45.  
 Morphia solution, composition of, 17.  
 Mortification, 218.  
 Mouth, wounds of, 75.  
 Muir, Sir W., on wounds of the lungs, 85.

## N.

NECK, wounds of, 76.  
 Necrosis of stump, 198.  
 Nélaton's probe, 41.  
 Nerves, wounds of, 150.  
 Neudörfer's plaster of Paris bandages, 30.  
 Nitrate of silver as a disinfectant, 50.  
 Nitric acid as a disinfectant, 50.  
 Non-penetrating wounds of chest, 79.  
 " of abdomen, 96.  
 Nose, injuries of, 74.

## O.

OAKUM as a dressing, 51.  
 Œsophagus, wounds of, 77.  
 Oil as a dressing for wounds, 45.  
 Ointments, 278.  
 Omentum, protrusion of, 99.  
 Operations, classification of, 263.  
 Opium for wounds, 45.  
 " in peritonitis, 106.  
 " smoking for tetanus, 227.  
 Ophthalmitis, 74.  
 Orbit, wounds of, 73.  
 Osteo-myelitis, 245.  
 Otis, U.S.A., on excision of hip-joint, 145.  
 Ovens, field construction of, 251.

## P.

PADS, extemporary, 26.  
 Pain in gun-shot wounds, 17, 45.

- Paget, Sir J., on pyæmia, 242.  
 Panniers, hospital, position of in action, 13.  
 Paper for extemporary pads, 26.  
 Paralysis as a symptom of injury of the spine, 108.  
 Parkes, Professor, on scurvy, 249.  
     " on footsoreness, 250.  
     " on water-filters, 254.  
 Patella, wounds of, 148.  
 Partial fractures, 116.  
 Pelvis, wounds of, 111.  
 Penetrating wounds of head, 62.  
     " of chest, 70.  
     " of abdomen, 98.  
     " of extremities, 39.  
 Perchloride of iron for hæmorrhage, 208.  
 Peritonitis, 106.  
 Perineum, wounds of, 114.  
 Pericardium, wounds of, 91.  
 Phagedæna gangrenosa, 228.  
 Phlebitis, 238.  
 Phrenic nerve, injuries above, 108.  
 Pigments, 278.  
 Pills, astringent, 278.  
     " cathartic, 279.  
     " alterative, 279.  
     " diuretic, 279.  
     " sedative, 279.  
 Pins, soldiers to be provided with, 17.  
 Pirogoff on duties at bandaging places, 16.  
     " on gun-shot fracture of femur, 124.  
 Pirogoff's amputation of foot, 182.  
     " plaster of Paris bandage, 26.  
 Plasters, 280.  
 Plaster of Paris bandage, Neudôrfer's, 30.  
     " Moffitt's, 27.  
     " Bavarian (Port's), 30.  
     " Volcer's, 31.  
     " Pirogoff's, 26.  
     " Port's, 30.  
     " Stromeyer's opinion on, 124.  
 Pleuritis, 86.  
 Pleura, foreign bodies in cavity of, 88.  
 Pneumonia in chest wounds, 86.  
 Pneumatic system of treating wounds, 51.  
 Pneumothorax, 91.  
 Pneumocele, 91.  
 Poland on exploring chest wounds, 81.  
     " on hæmorrhage from the lungs, 83.  
 Poles for extemporary stretchers, 11.  
 Polli on pyæmia, 242.\*  
 Pollock on wounds of the intestines, 99.  
 Porter, Professor, on irrigation of stumps, 158.  
     " " on ligature of femoral artery, 214.  
     " G. H., on ligature of femoral artery, 215.  
     " J. H., sling for treatment of bed-sores, 221.  
 Port's plaster of Paris bandage, 30.  
 Position of soldier in exploring wounds, 39.  
 Potash permanganate as a disinfectant, 50.  
 Potash silicate for splints, 25.  
 Poultices, 50.  
 Powders, 280.  
 Primary operations at sieges, 15.  
     " after engagements, 15, 16.  
 Primary amputation, 153.  
 Preparations for the field, 13.  
 Probes, 41.  
 Probe, De Wilde's, 42.  
     " Tailor's electric, 42.  
     " Lecomte's, 41.  
     " Liebreich's, 42.  
     " Nélaton's, 41.  
 "Probe nippers," 41.  
 Protrusion of brain, 67.  
     " of intestine, 98.  
 Public buildings for wounded, 15.  
 Punctured wounds, 37.  
 Pyæmia, 240.  
  

R.

 RADIUS, injuries of, 120.  
 Rattan splint, 24.  
 Rectum, wounds of, 114.  
 Reef knot, 210.  
 Resection, operations for, 183.  
     " Stromeyer's opinion on after-treatment, 141.  
     " Lœffler's opinion on, 141.  
     " Hannover's opinion on, 141.  
 Rifles for extemporary stretchers, 7.  
 Ribs, fractures of, 79.  
 Ropes for extemporary stretchers, 9.  
 Rupture of liver, 97.  
     " stomach, 97.

Rupture of spleen, 97.  
 „ kidney, 97.

## S.

SALIVATION in wounds of the mouth, 72.  
 Sawdust for pads, 26.  
 Sarazin's splint, 136.  
 Scabbard of sword for splint, 21.  
 „ of bayonet for splint, 22.  
 Scalp wounds, 59.  
 Scapula, excision of, 184.  
 Scored splints, 23.  
 Scrotum, wounds of, 114.  
 Scurvy, 249.  
 Sea-weed for pads, 26.  
 Second line of surgical assistance, 15.  
 Septicæmia, 243.  
 Sequestra, classification of, 127.  
 Shaving of cork for pads, 26.  
 Shelter for wounded, 15.  
 Shock, 17, 152.  
 Shoulder-joint, injuries of, 142.  
 „ amputation at, 161.  
 Shirts for extemporary stretchers, 10.  
 Silicate of potash for splints, 25.  
 Skey's operation on the wrist, 185.  
 „ method for excision of the hip, 187.  
 Sling for treatment of bed sores, 221.  
 Sloughing ulcer, 228.  
 Smith's anterior splint, 131.  
 Solid bullet, wound inflicted by, 39.  
 Spasm of stump, 198.  
 Spine, wounds of, 107.  
 Spinal cord, concussion of, 107.  
 „ compression of, 103.  
 Spleen, rupture of, 97.  
 Sponges, 50.  
 Splint, scored, 23.  
 „ wire, 23.  
 „ zinc, 23.  
 „ tin, 23.  
 „ cane, 24.  
 „ leather, 26.  
 „ whalebone, 23.  
 „ gutta-percha, 23, 71.  
 „ Duncan's, 24.  
 „ Wyatt's, 24.  
 „ gauze, 23.

Splint, extemporary, 18.  
 „ twigs or brushwood, construction of, 26.  
 „ for lower jaw, 72.  
 „ Hamilton's, for humerus, 119.  
 „ Hodgen's, for thigh, 129.  
 „ Stromeyer's, ditto, 135.  
 „ Sarazin's, ditto, 136.  
 „ Smith's, ditto, 131.  
 „ Erichsen's, ditto, 134.  
 „ Erichsen's, for excision of head of femur, 188.  
 „ Esmarch's, for fracture of femur, 133.  
 „ „ for excision of ankle, 195.  
 „ „ for do. elbow, 143.  
 „ „ for do. wrist, 144.  
 „ Lister's, for do. do. 187.  
 „ Butcher's, for do. knee, 190.  
 „ Watson's, for do. do. 191.  
 „ Gooch's, for do. do. 191.  
 Stimulants for wounded, 13, 17.  
 Stitches for wounded intestine, 100, 103.  
 Stomach, rupture of, 97.  
 Straps for extemporary stretchers, 7.  
 Straw ropes do. 8.  
 Straw for extemporary splints, 21.  
 „ for transporting wounded on, 9.  
 „ for extemporary pads, 26.  
 Stretchers, carriage of wounded on, 2.  
 „ extemporary, 6.  
 Stromeyer on chest wounds, 85.  
 „ on the trephine, 63.  
 „ on gun-shot fractures of the femur, 123.  
 „ on wounds of the knee-joint, 147.  
 „ on wounds of the ankle-joint, 148.  
 Stromeyer's pad for fracture of humerus, 118.  
 „ splint for fractures of the lower extremities, 135.  
 Stumps, washing out of, 158.  
 „ the after-treatment of, 158.  
 „ transporting of, 158.  
 „ affections of, 198.  
 „ maggots in, 159.  
 „ hæmorrhage from, 201.  
 "Styilet pince," 41.  
 Styptics, 207.  
 Suppositories, 280.  
 Surgical instruments, care of, 2.  
 Swiss tourniquet, 205.

Sword wounds, 37, 52.  
 Syme's amputation at knee, 175.  
 " " ankle, 177.

## T.

TAILOR's electric explorer, 42.  
 Taylor's classification of wounds, 258.  
 " " operations, 263.  
 Tablets for diagnosing, 15.  
 Tarsus, amputation at, 179.  
 Tarsal bones, excision of, 195.  
 Tendons, wounds of, 150.  
 Testicles, wounds of, 114.  
 Tetanus, 223.  
 Thigh, gun-shot fractures of, 121.  
 " simple fractures of, 121.  
 " difficulties in transporting with fracture of, 18, 121, 122.  
 " splints for, 129, 130, 131, 132, 133.  
 " extemporary splints for, 19.  
 Tin for splints, 23.  
 Tongue, wounds of, 75.  
 Torsion of arteries, 206.  
 Tourniquet, 203.  
 " Mott's, 204.  
 " Esmarch's, 205.  
 " Swiss, 205.  
 " Volcker's, 204.  
 Transport, extemporary, 6.  
 Travers on wounds of intestines, 102.  
 Trees, small branches of, for extemporary carriage, 9.  
 Trephine, necessity for use of, 62.  
 " application of, 68.  
 " where not to be applied, 66.  
 " in injuries of the spine, 109.  
 Tunics for extemporary stretchers, 8.

## U.

URETHRA, wounds of, 114.  
 Upper extremities, wounds of, 117.  
 Ulna, fracture of, 120.

## V.

VAGUS nerve, injury of, 107.  
 Veins, wounds of, 208.

Velpeau's irrigator, 48.  
 Volcker's plaster of Paris bandage, 31.  
 Vernal's method of amputation of thigh, 174.  
 Ventilation, 51.

## W.

WARM bath for wounds, 47.  
 " water for wounded, 46.  
 Water filters, extemporary, 254.  
 " distribution of, 255.  
 " for wounded, 13, 15.  
 Watson, Sir T., on tetanus, 227.  
 Watson's, P., splint for excision of the knee, 190.  
 Wire splints, 23.  
 Wind balls, 38.  
 Whalebone splints, 23.  
 Wool, cotton, for dressing wounds, 52.  
 Woorali in tetanus, 225.  
 Wolseley, Sir Garnet, on construction of cooking-places, 251.  
 Wounded, accommodation for, 15.  
 " examination of, 39.  
 " distribution of, 15.  
 Wounds, classification of, 258.  
 " how influenced, 39.  
 " exploration of, 39.  
 " incised, 37.  
 " punctured, 37.  
 " lacerated, 37.  
 " contused, 38.  
 " sword, 37.  
 " lance, 52.  
 " arrow, 52.  
 " gun-shot, 44.  
 " of scalp, 59.  
 " face, 70.  
 " ear, 73.  
 " orbit, 73.  
 " eye-ball, 74.  
 " nose, 74.  
 " cheeks, 74.  
 " forehead, 74.  
 " tongue, 75.  
 " mouth, 75.  
 " neck, 76.  
 " larynx, 77.

## Wounds of œsophagus, 77.

- " chest, 79.
- " pericardium, 91.
- " heart, 92.
- " lungs, 80.
- " diaphragm, 93.
- " abdomen, 96.
- " intestine, 100.
- " spine, 107.
- " pelvis, 111.
- " bladder, 113.
- " perineum, 114.
- " urethra, 114.
- " penis, 114.
- " scrotum, 114.
- " testicle and cord, 114.
- " anus and rectum, 114.
- " extremities, 115.
- " wrist-joint, 144.
- " hip-joint, 145.

## Wounds of knee-joint, 146.

- " ankle-joint, 148.
- " elbow-joint, 143.
- " shoulder-joint, 142.
- " patella, 148.
- " arteries, 199, 203.
- " veins, 208.

## Wyatt's splint, 24.

## Wyatt on septicæmia, 243.

## Wrist, wounds of, 144.

- " excision of, 185.
- " amputation at, 167.
- " Esmarch's splint for, 144.
- " Lister's splint for, 187.

## Z.

## Zinc splints, 23.

- " chloride as a disinfectant, 50.



LONDON  
PRINTED BY WILLIAM CLOWES AND SONS,  
STAMFORD STREET AND CHARING CROSS.

5

# MEDICAL WORKS.

By WILLIAM AITKEN, M.D., F.R.S.,

*Professor of Pathology in the Army Medical School; Corresponding Member of the Royal Imperial Society of Physicians of Vienna, of the Society of Medicine and Natural History of Dresden, and of the Imperial Society of Medicine of Constantinople.*

## THE SCIENCE and PRACTICE of MEDICINE.

In 2 vols., 2300 pages, demy 8vo., with Steel Plate, Map, and nearly 200 Engravings. SIXTH EDITION, thoroughly revised. Price 38s.

"We know of no work that contains so much, or such full and varied, information on all topics connected with the Science and Practice of Medicine."—*Lancet*.

"The extraordinary merit of Dr. Aitken's book. . . . The author has unquestionably performed a service to the profession of the most valuable kind."—*Practitioner*.

"There is, perhaps, no work in the English language more indispensable to the Practitioner and Student."—*Edinburgh Medical Journal*.

Now ready, crown 8vo., cloth, bevelled, 12s. 6d.

## OUTLINES of the SCIENCE and PRACTICE of MEDICINE: A Text-Book for Students.

"Well digested, clear, well written, and the work of a man conversant with every detail of his subject."—*British Medical Journal*.

"So complete as to form a useful work of reference. . . . concise and systematic."—*Lancet*.

12mo., cloth, 2s. 6d.

## THE GROWTH OF THE RECRUIT and the

Young Soldier, with a view to the Selection of "Growing Lads" and their Training.

"This little work should be in the hands of all instructors of youth, and all employers of youthful labour."—*Lancet*.

## OUTLINE FIGURES OF THE TRUNK OF THE

HUMAN BODY: On which to indicate the Areas of Physical Signs in the Clinical Diagnosis of Disease. For the use of Students and Practitioners of Medicine. 1s. 6d.

In preparation. Royal 8vo., cloth, with Illustrations, Diagrams, and Map.

## A DICTIONARY OF HYGIÈNE AND PUBLIC

HEALTH: Comprising Sanitary Chemistry, Engineering, and Legislation, the Dietetic Value of Foods, and the Detection of Adulterations. On the plan of the "Dictionnaire d'Hygiène Publique" of Professor AMBROISE TARDIEU. By ALEXANDER WYNTER BLYTH, M.R.C.S., L.S.A., A.K.C., &c., Analyst to the County of Devon, Medical Officer of Health, &c.

Post 8vo., cloth, illustrated, 5s.

## A MANUAL OF INSTRUCTION FOR ATTEND-

ANTS ON SICK AND WOUNDED IN WAR. By Staff-Assistant-Surgeon A. MORFITT, of the Royal Victoria Hospital, Netley. Published under the Sanction of the National Society for Aid to the Sick and Wounded in War.

CHARLES GRIFFIN & CO., 10, Stationers' Hall Court, London.











